April 23, 1956 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Air Transport Facts and Figures

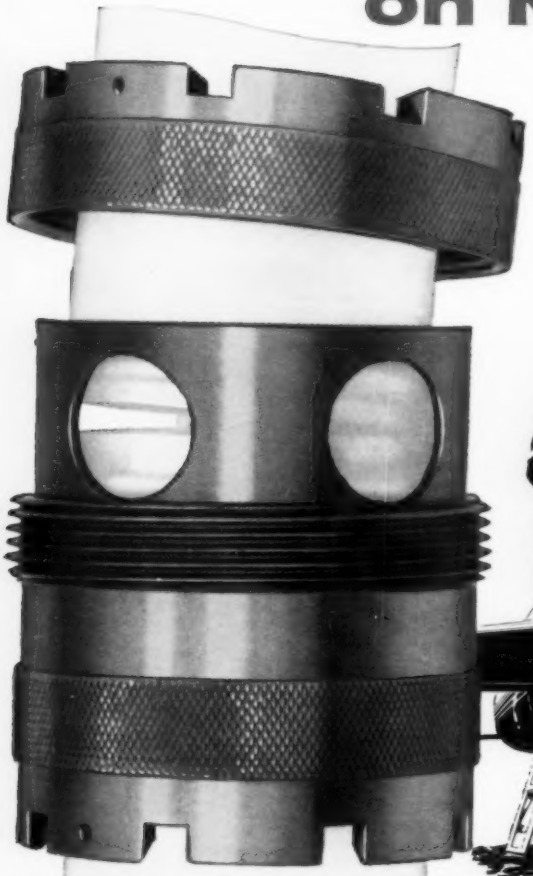
•

Detail Report on Lockheed F-104A

Lockheed XF-104

E B POWER GS
UNIVERSITY MICROFILM INC
313 N 1ST ST
ANN ARBOR MICH

WIG-O-FLEX® couplings save 46 pounds on North American F-100c



Flexible union for connecting rigid tubes

THE WORLD'S FIRST supersonic speed record holder – the North American F-100C SUPER SABRE – is 46 pounds lighter because WIG-O-FLEX Couplings replaced standard AN connections and cut hose. WIG-O-FLEX Couplings weigh 1/5 as much as the standard AN connections they can replace.

Write for further information.

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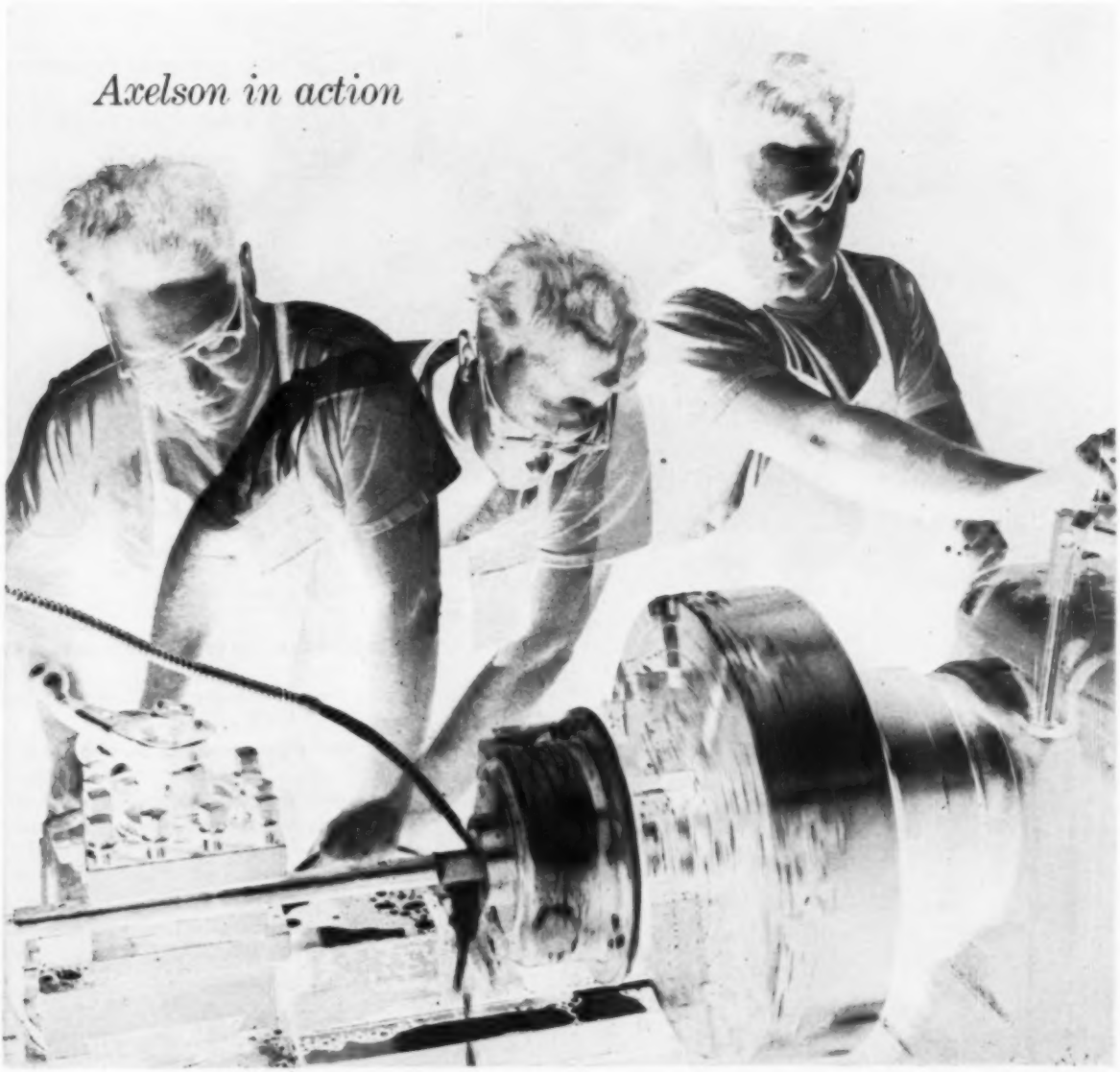

negative problem... positive solution

Removing metal accurately and quickly can be a problem. It requires the skill and experience of master craftsmen . . . the finest machine tools . . . it requires a positive approach. Only then can the product meet exacting specifications of economy and precision.

For more than thirty years Axelson has specialized in the positive solution of difficult production problems for aircraft components and subassemblies. Today, our history of accomplishment is being perpetuated by Axelson's production technicians, carefully trained in the specific machine tool operations required for the production of precision aircraft parts.

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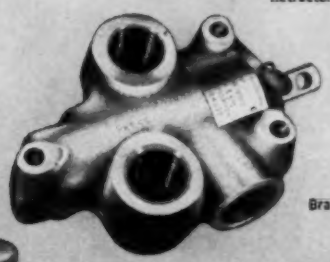
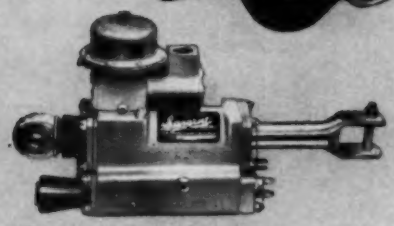
Sargent

hydraulic, pneumatic and mechanical aircraft controls

2 Main Landing Gear Retractor



3 Brake Valves



4 Power control units for rudder, elevators and flaperons

5 Slat Actuating Cylinder

6 Gear Box Assembly — Outer Wing Flap Drive

7 Pneumatic Door Lock

provide precision performance

For more than 35 years Sargent Engineering Corporation has designed and manufactured precision equipment.

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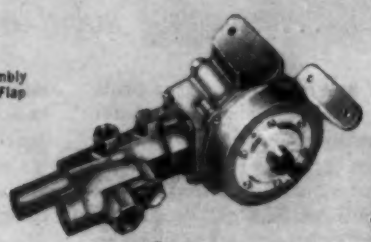

8 Spoiler Valve

9 Accessory Drive Power Take-off

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"Good will" is the disposition of the pleased customer to return to the place where he has been well treated.
— U. S. Supreme Court

AVIATION CALENDAR

Apr. 26—Institute of Navigation, annual regional meeting, Friendship International Airport, Baltimore, Md.

Apr. 26-27—Aeronautical Training Society, annual meeting, Mayflower Hotel, Washington, D. C.

Apr. 26-27—11th Annual Management Engineering Conference, Society for Advancement of Management-American Society of Mechanical Engineers, Hotel Statler, New York.

Apr. 26-27—Institute of the Aeronautical Sciences Southeastern Student Conference, Georgia Institute of Technology, Atlanta. **May 3-4—Sixth Annual West** Coast Student Conference, Los Angeles.

Apr. 30-May 4—Society of Aeronautical Weight Engineers, 15th national conference, El Cortez Hotel, San Diego.

May 1-3—Annual Electronics Components Symposium, Dept. of Interior Auditorium, Wash., D. C., sponsored by American Institute of Electrical Engineers, Institute of Radio Engineers, Radio-Electronic-Television Manufacturers Assn. and West Coast Electronic Manufacturers Assn.

May 2-3—Air Traffic Conference of the Air Transport Assn., spring meeting, Hotel Radisson, Minneapolis, Minn.

May 2-5—Twelfth Annual National Forum of the American Helicopter Society, Sheraton-Park Hotel, Wash., D. C.

May 6-9—Second Annual Symposium on Flight Test Instrumentation, sponsored by Instrument Society of America, Bell Aircraft Corp., Convair and Temco Aircraft Corp., Hotel Texas, Fort Worth.

May 7-11—American Welding Society, annual spring meeting, Hotel Statler, Buffalo, N. Y.

May 13-23—Seventh All Woman's International Air Race, Hamilton, Ont., Canada to Havana, Cuba.

May 16-18—Society for Experimental Stress Analysis, spring meeting, William Penn Hotel, Pittsburgh, Pa.

May 18—Armed Forces Day Dinner, Sheraton-Park Hotel, Wash., D. C.

May 17-19—New York State Society of Professional Engineers, 30th Engineering Industries Exposition and annual convention, Statler Hotel, New York.

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OPERATION HUNTER-KILLER

1600 hours. U.S.S. Tarawa launches 2 Grumman S2F airplanes to sink an "enemy" sub stalking HUK Group IV from an area 70 miles away during recent Anti-submarine Warfare Operations in the Caribbean Sea.

AIR ATTACK FROM DAVY JONES

0900. No datum. All night planes and destroyers have fed reports to Tarawa's darkened Combat Intelligence Center. The plot boards show only friendly shipping.

1618. S2F's start search with electronic gear that can detect snorkel, periscope, or sub radar, even the submerged sub's disturbance of the earth's magnetic field.

1900. Relief S2F's are launched; the others recovered aboard carrier. S2F's in the air keep the sub under and blind, afraid to even show periscope at night.

An enemy could air attack our cities with missiles launched from submarines. With the air-breathing snorkel and atomic power, the submarine has become a true and most elusive submersible. Your Navy's counter weapon is the Hunter-Killer Group, dedicated officers and men on destroyers and carriers operating Grumman S2F sub-killers.

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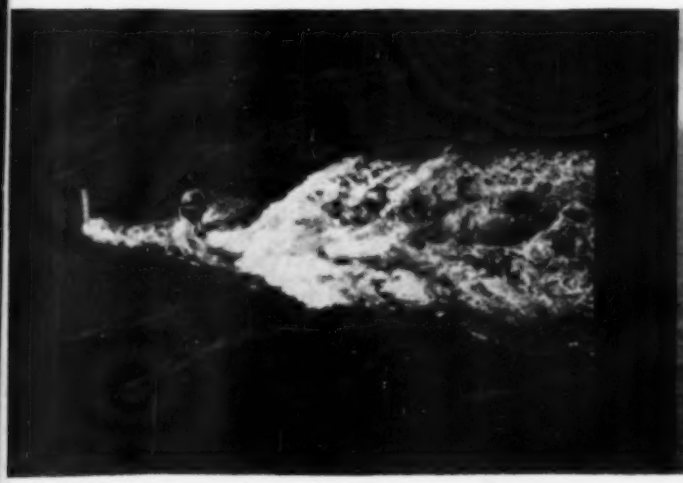
Designers and builders also of the supersonic F11F-1 Tiger, transonic F9F-8 Cougar, SA-16 Albatross rescue amphibian, metal boats, and Aerobilt truck bodies.

0905. An S2F makes radar contact. Snorkel 8 miles away. Gone. The diving S2F drops sonar buoys. Echoes. Fix! He attacks with depth charges and homing torpedo.



0920. S.S. Piper surfaces to say she has been "sunk". S2F's return to Tarawa, ending the 4-week war games during which the sub scored no hits on the task force.

Jessie L. Bathgate
Chief Stewardess

Earnest H. Brown
Personnel

Stanley J. Cavill
Chief Pilot

Harold W. Coward
Flight Operations

Robert Gallagher Jr.
Chief Flight Engineer

John I. Good
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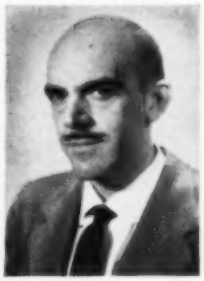

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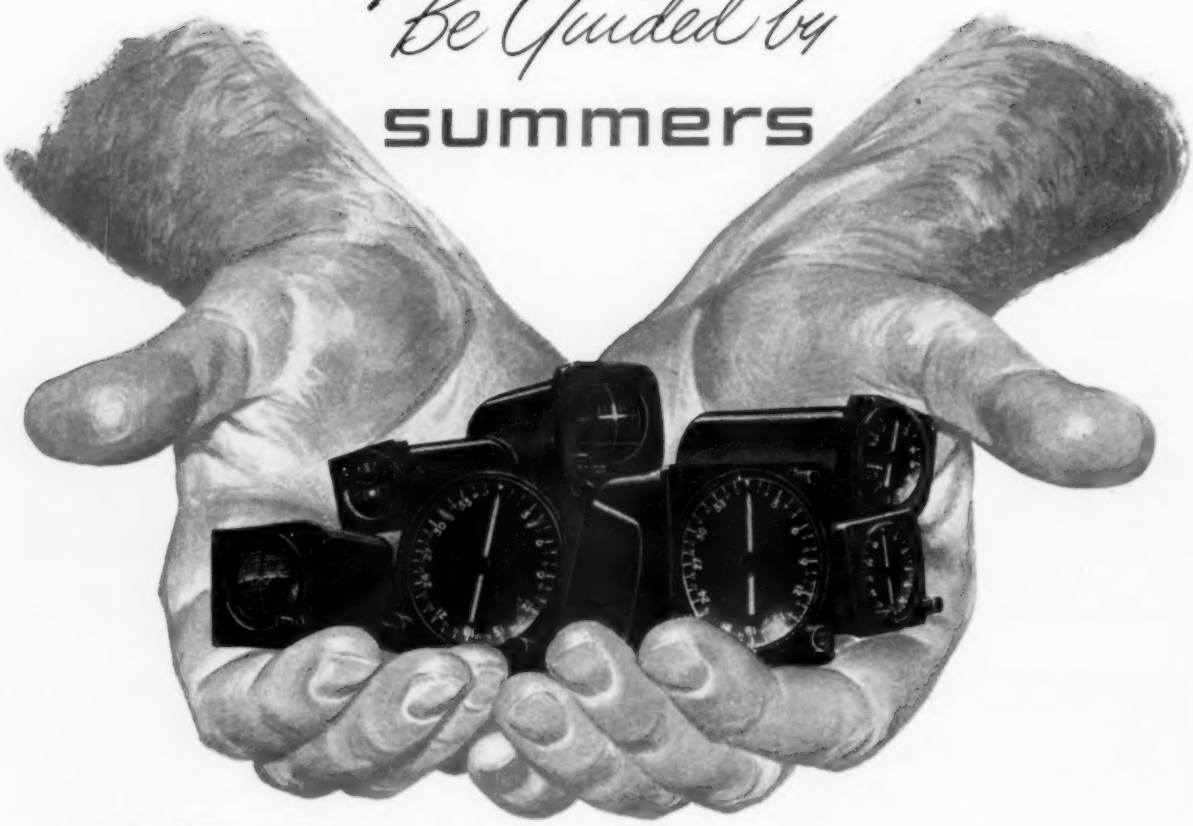
# of America's Senior Airline

Be Guided by

summers



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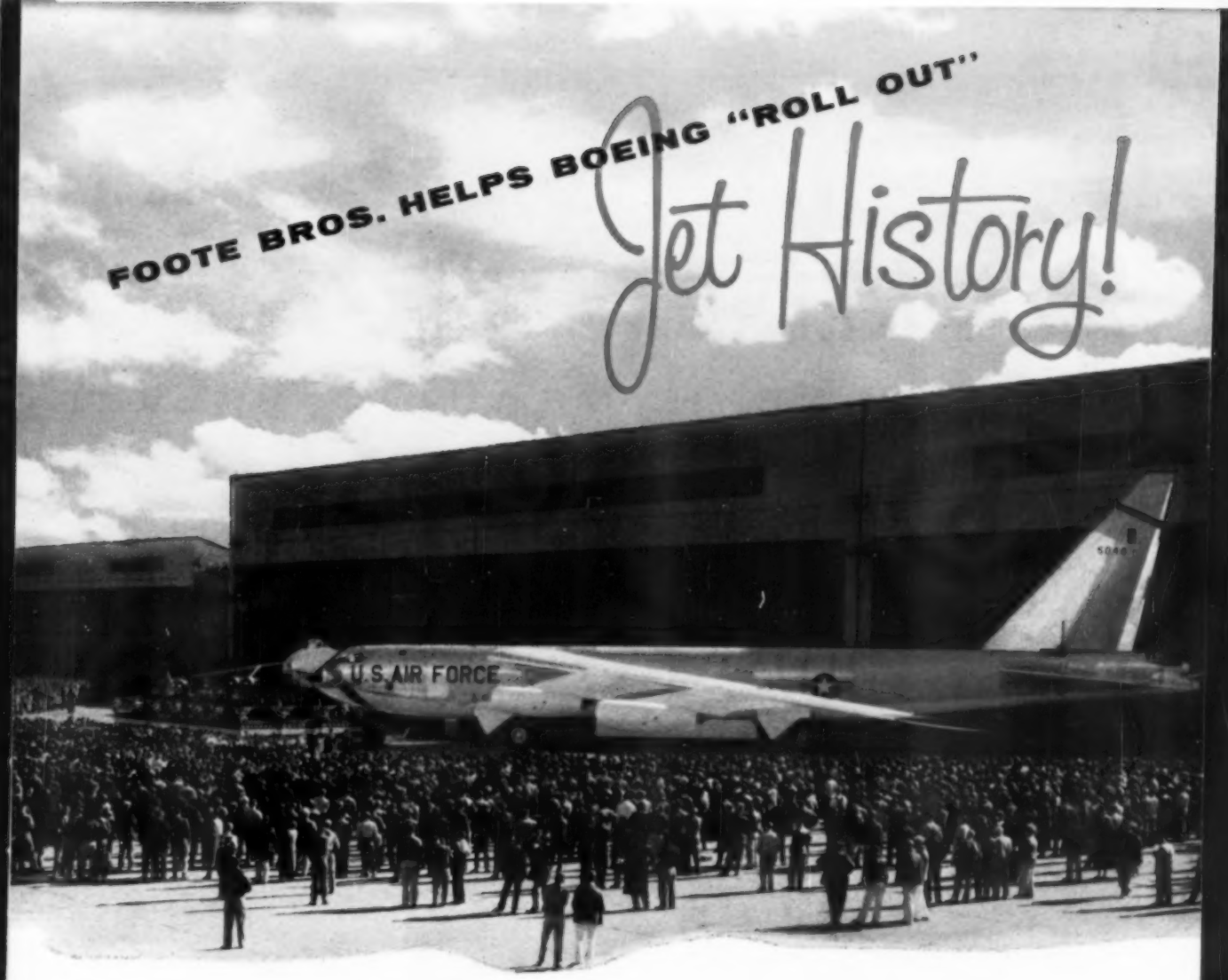

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Jet history was made on December 7, 1955 when the first Wichita-built B-52 Stratofortress was rolled from Boeing's Wichita plant. This giant was completed four months ahead of the original Air Force schedule . . . representing a unique achievement in planning, engineering and production.

Foote Bros. is proud to have played a part in making this accomplishment possible. The stabilizer trim mechanism, flap drive assembly, wing flap screw assemblies and angle gear boxes for this model plane are some of the many precision assemblies currently being produced by Foote Bros. to meet the complex requirements of today's near sonic, sonic and supersonic aircraft and guided missiles. They represent the very finest in engineering, manufacturing technique, quality control and reliability.

Aircraft industry leaders look first to Foote Bros. for precision gearing and geared assemblies such as control surface actuators, jet engine gears, propeller pitch control gears, canopy actuators, and accessory drive units. It will pay you, too, to see Foote Bros. first for your precision requirements.

A FEW OF THE new

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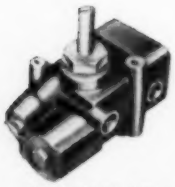
AIRBORNE HYDRAULIC VALVES

Hydraulic Motor with Anti-Overrun Flow Control



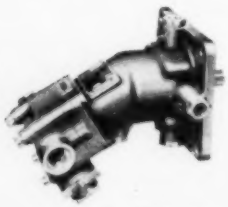
Constant Gain Nose Wheel Steering Valve

from New "Concept-through-Production" Facility at El Segundo Division

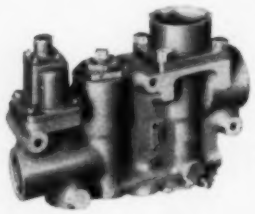
The valves shown are representative of an expanding line being built to meet rapidly advancing airborne requirements. They were developed in close cooperation with the airframe and power plant engineers who are using them. They are products of Vickers El Segundo (California) Division, which has complete engineering, laboratory and production facilities for "concept-through-production" of airborne hydraulic valves.

Thoroughly experienced in the requirements of aircraft systems and working closely with the Detroit organization, the El Segundo staff can quickly solve new problems in design. As soon as the prototype is approved, it becomes a production item in minimum time. Ask the nearest Vickers Application Engineer for further information or write for Bulletin A-5209.

Flow-Sensitive Pressure Regulator



Motor with Constant Speed Valve



Pump Control Valve

Relief Valve with Thermal Protection

Power Control Flow Regulator

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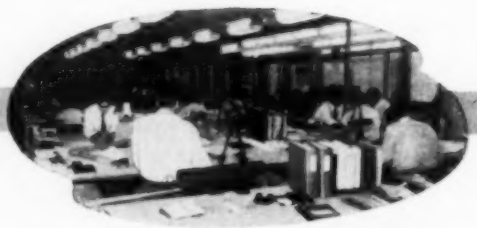
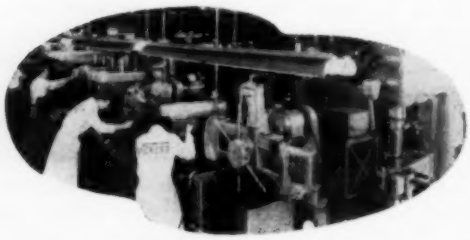
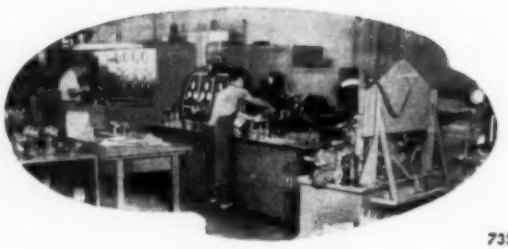


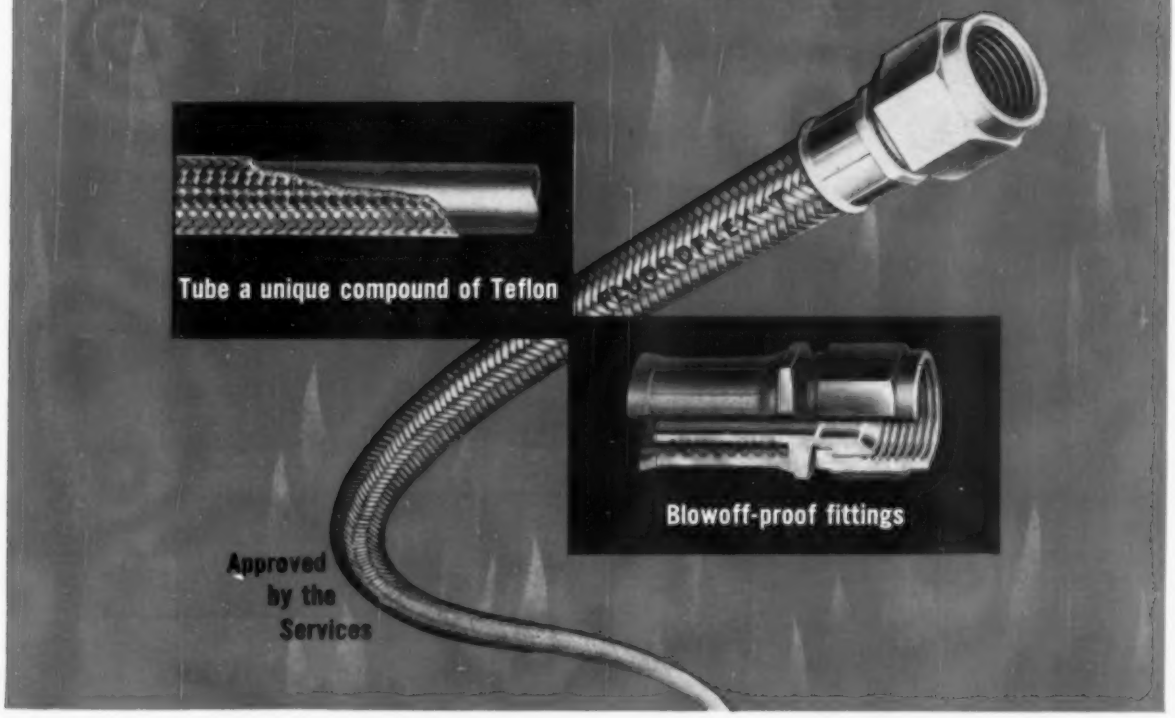
Design, Development, Testing and Manufacturing at El Segundo Division of Vickers Incorporated.





7352

Why this Teflon® hose proves reliable even at 500F° ambiance



THIS HOSE has the exclusive Fluoroflex®-T tube . . . a special compound of Teflon. The unique extruding process developed by Resistoflex produces tubing that assures consistent high performance at high temperatures from Fluoroflex-T R500 hose. Its reliability is a matter of record.

As for the fitting, it's a compression type . . . for *permanent* reliability. It puts no damaging stresses on the stainless steel wire braid or Teflon tube. Over three years' *actual flying service* back up the positive protection this superior design gives against blowoffs at elevated temperatures and working pressures.

Proved quality, *proved* service life, and *approved* by the Services and CAA . . . that's Fluoroflex-T hose, the *original* Teflon hose. Send for Bulletin FH-2.

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20th year of service to industry

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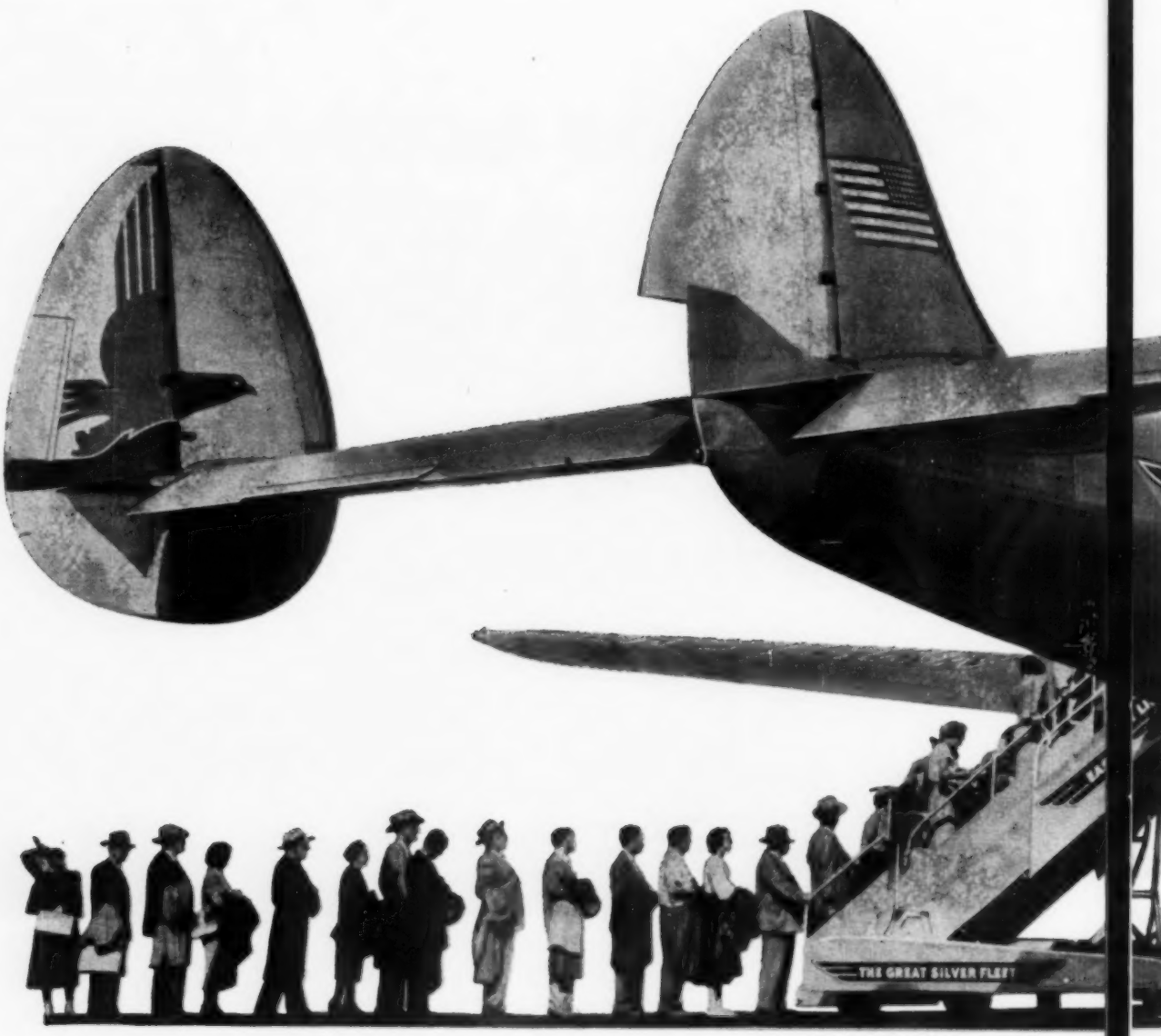

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It is not surprising then, that 45% of the aircraft oils used by major scheduled airlines in the U. S. is supplied by Sinclair. There is no better proof of dependability.

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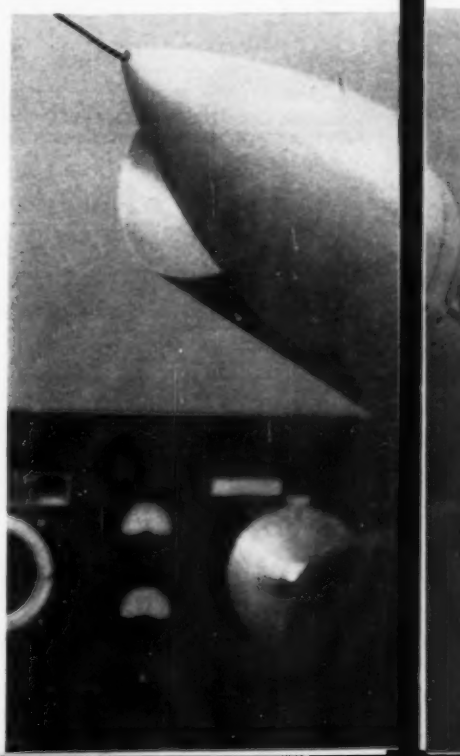
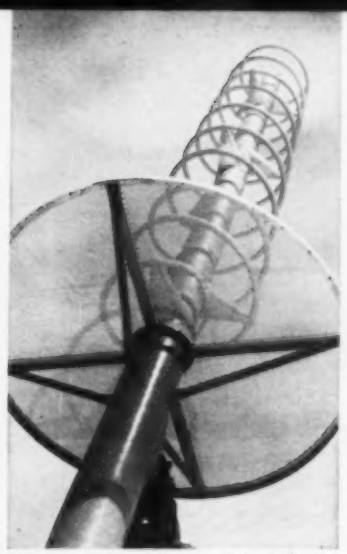
Lockheed Scientists– a new type of bird-man

Pioneer bird-men risked their lives to prove that man could fly. Today's bird-men are the scientists who dedicate their lives to research in the field of missiles (fantastic new "birds" which challenge the imagination) and to the development of the complex missile systems, so important to our defense efforts. Their work is secret, exciting and second to none in military importance—because America's supremacy in aerial weapons faces a menacing challenge.

Lockheed is helping the U.S. armed forces meet that challenge by the rapid expansion of its Missile Systems Division. At Van Nuys, California, a staff of over 3,000 workers is already deeply engaged in top-secret projects for the Air Force. Two new missile research laboratory buildings are being constructed by Lockheed on a 22-acre site in Stanford University's industrial park area at Palo Alto, California. And nearby, on a 275-acre site at Sunnyvale, Lockheed is building extensive engineering and manufacturing facilities.

Everyone at Lockheed's Missile Systems Division is working with a sense of deep urgency to help the nation retain its superiority in missile systems technology—and thus deter attack from any potential aggressor.





A VITAL PHASE of successful missile systems research and development is the testing of vehicles and components under actual operating conditions. This helical antenna (above) receives telemetered data transmitted from test missiles.

(ABOVE) SCIENTISTS at Missile Systems Division using cold-flow test chamber to obtain data on flow rate of liquid fuels at the extreme temperatures which might be encountered by a supersonic, high-altitude missile in flight.

(AT LEFT) DR. LOUIS N. RIDENOUR, first Chief Scientist of the U.S. Air Force (1950-51), now Research Director of Lockheed Missile Systems Division, shown with a senior scientist and a student-scientist* discussing simulated trajectory of a high-altitude ballistic missile. Lockheed's advanced research programs include: conditions bearing on flight into space, chemical propulsion systems, power applications of nuclear energy, physical studies of environments created by radioactivity, advanced studies of applications of electronic phenomena, new principles in the remote guidance field, and others.

(BELOW) A DEMONSTRATION MODEL, used to illustrate the fundamentals of telemetering systems. Many advanced contributions in this field, as well as in the fields of guidance control and data reduction, have been made by Lockheed's Missile Systems Division.

(ABOVE) The speed-up construction program now under way at Palo Alto will permit use of Lockheed's new research laboratories by the start of the fall semester at Stanford University.

**Lockheed's Advanced Study Program helps outstanding students, while employed, achieve MS degrees in Mathematics, Electrical and Mechanical Engineering, Aeronautics and other Physical Sciences. Write: Lockheed Missile Systems Division, Van Nuys, California.*

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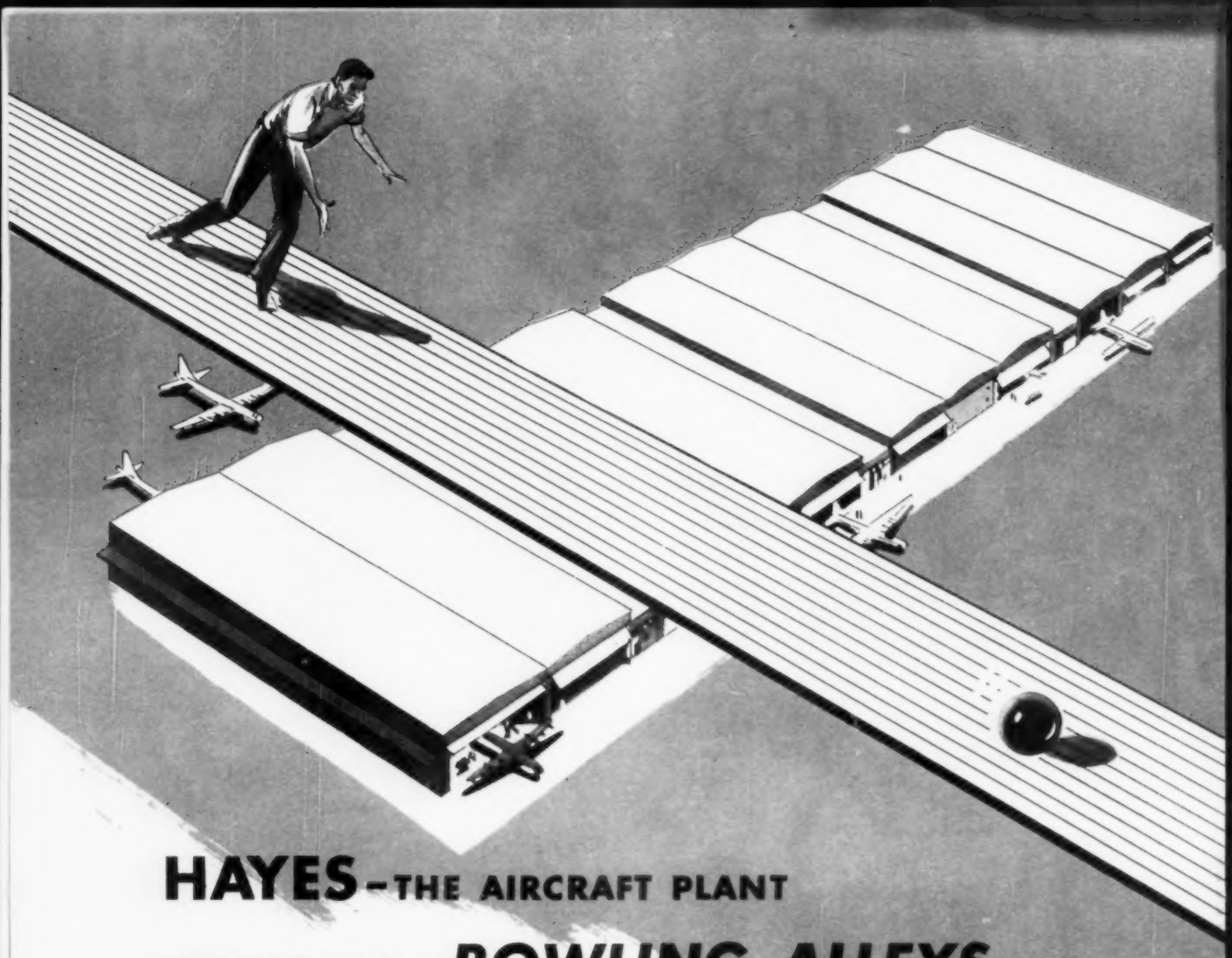

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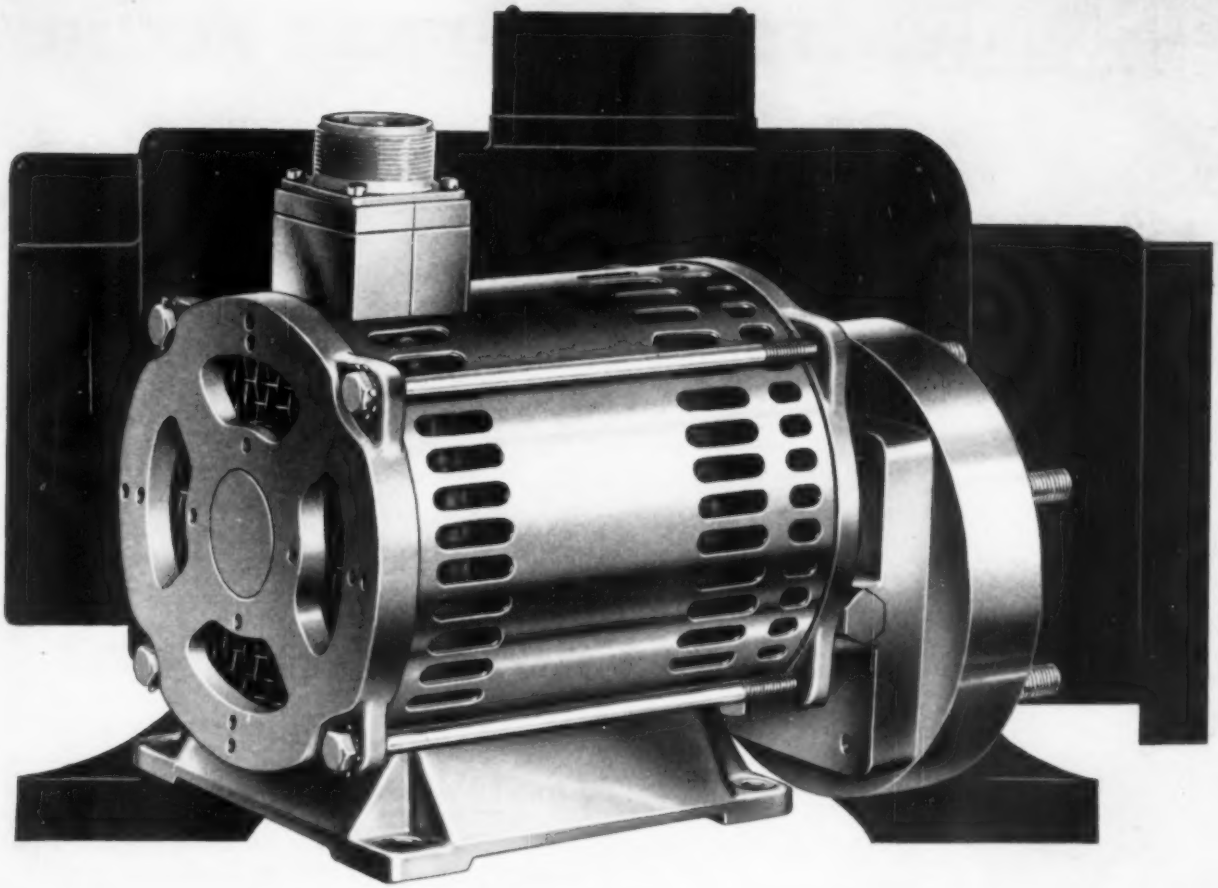

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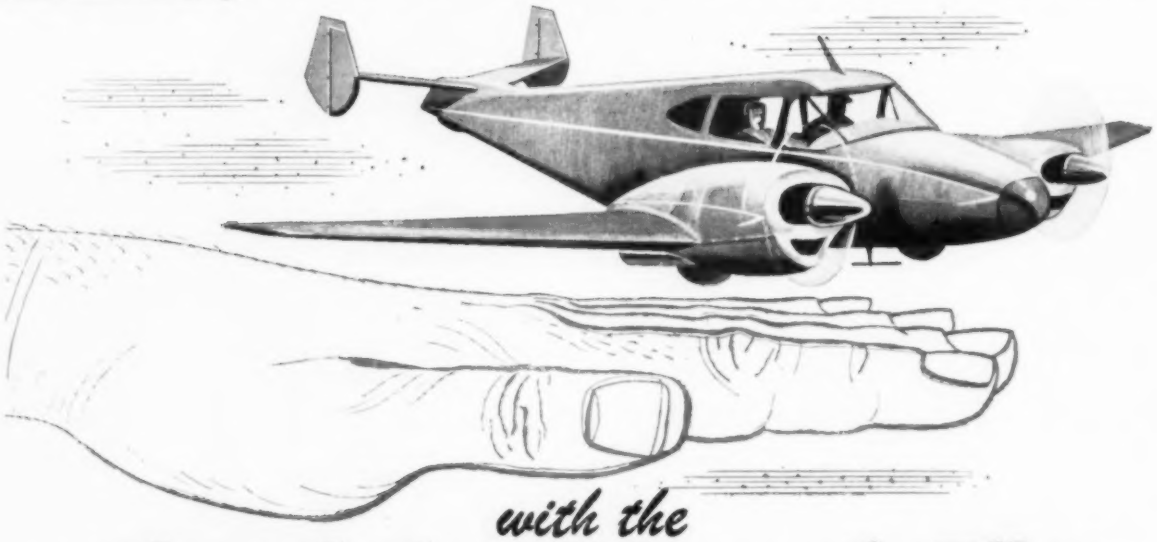

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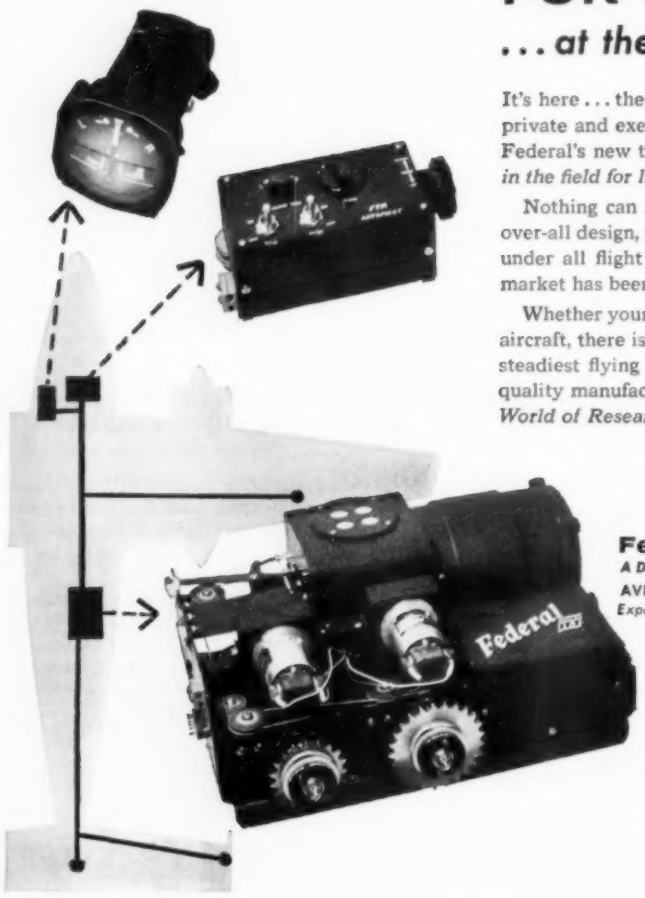

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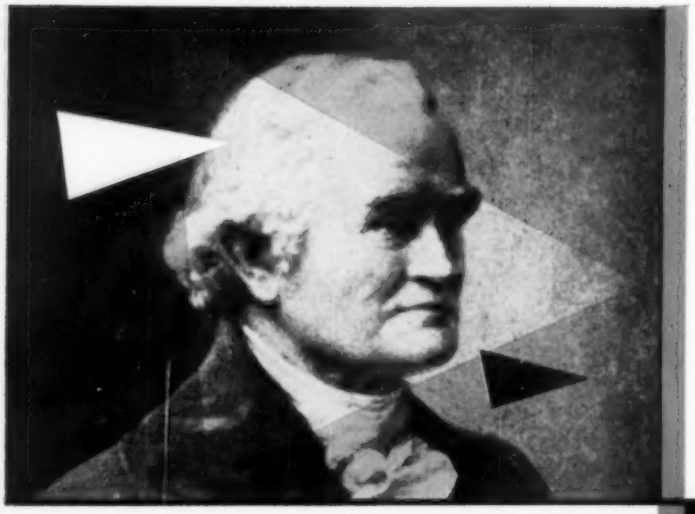

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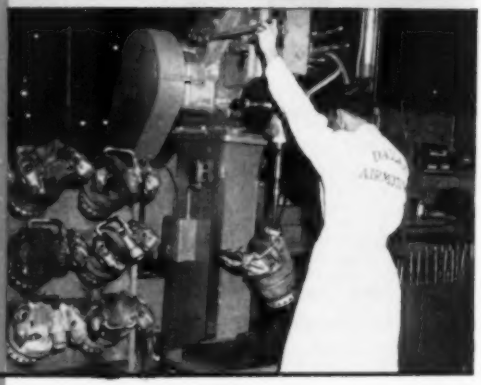

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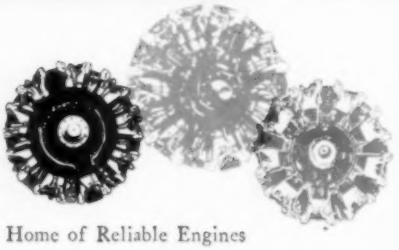

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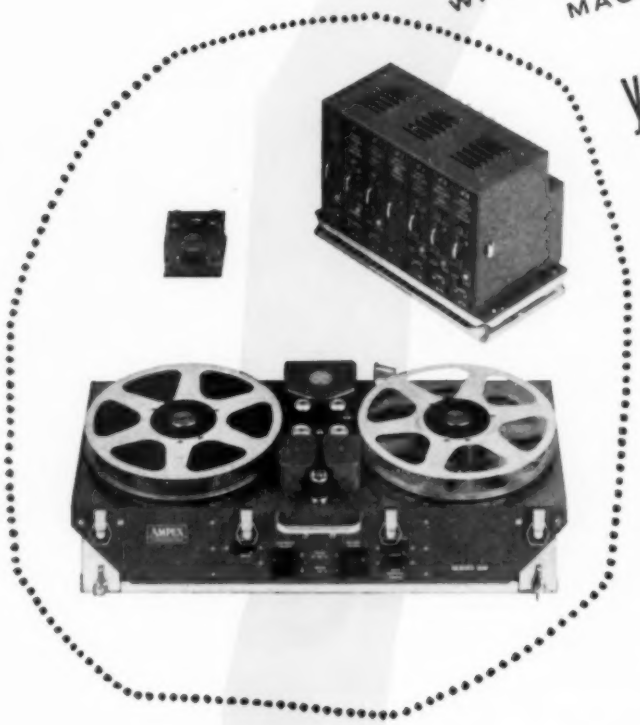

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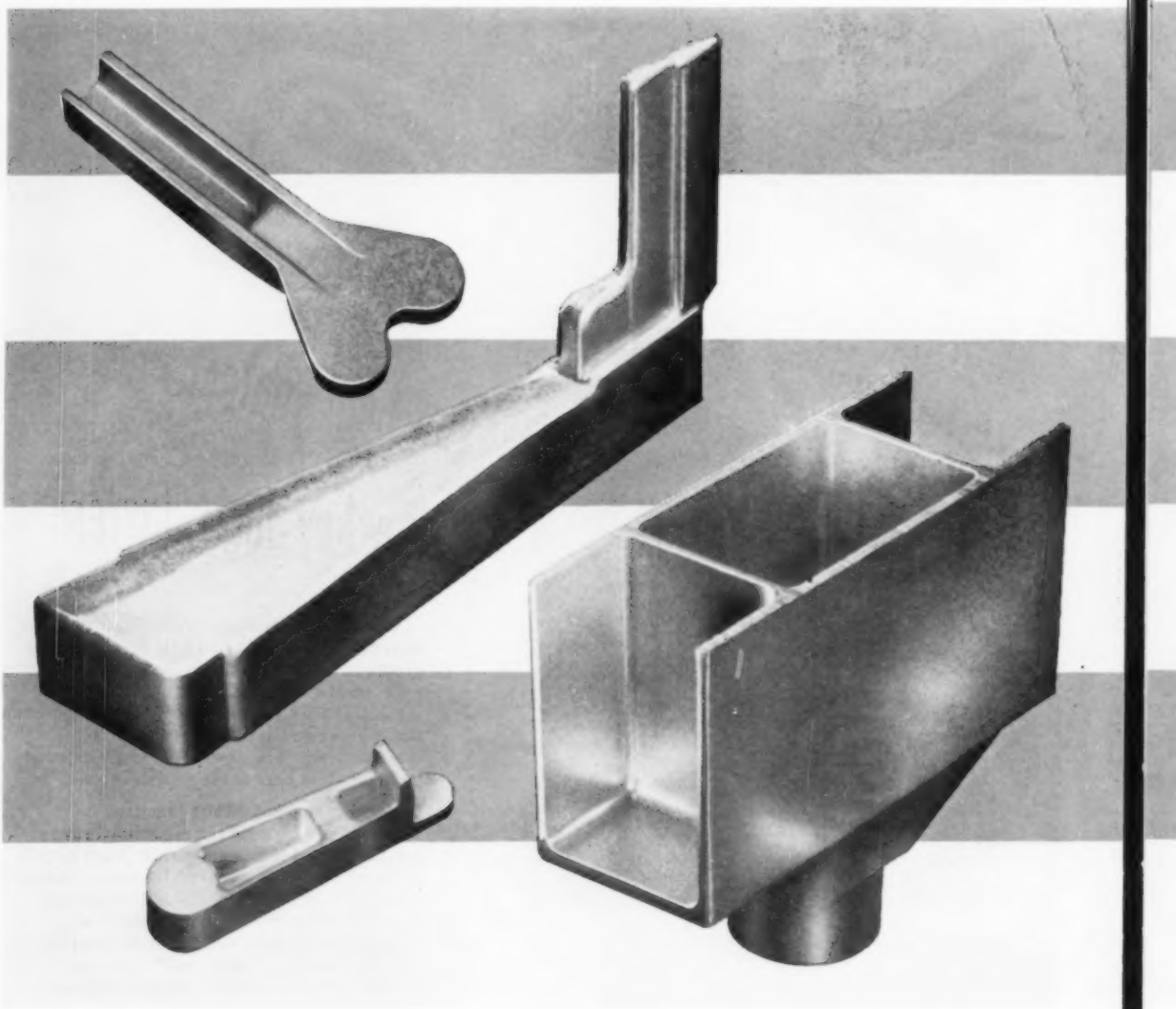

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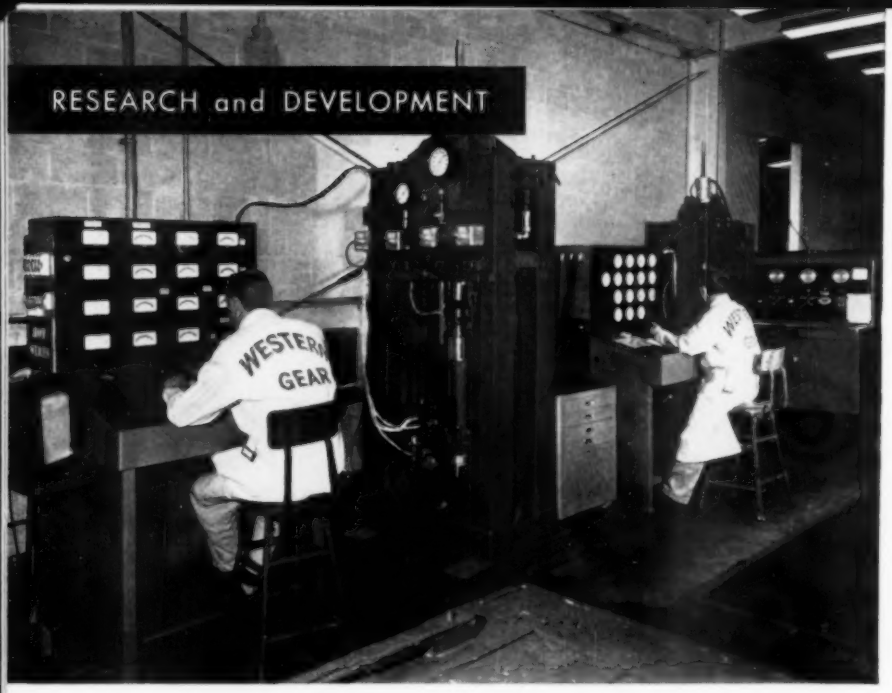

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The Role of Modern Test Facilities in the Design of Aircraft Gear Drives

by John Morris

Manager of Engineering, Western Gear Corporation

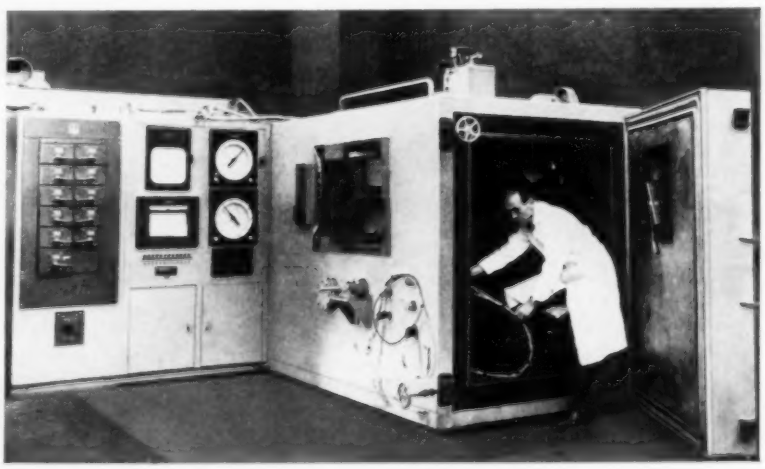
Modern aircraft, whether it be piloted or electronically guided, requires mechanical devices of utmost reliability. No longer can the designer depend entirely upon experience but must have available extensive equipment capable of producing the environments and loading conditions which will check the newly designed parts to the conditions encountered on its assigned mission.

This environmental test equipment must be operated by experienced personnel under the guidance of engineers capable of correlating and analyzing test results and their actual relation to final installations before a suitable product can be designed, produced, and proven. Mother Nature in her unlimited weather laboratory produces extreme variations of the elements in almost incalculable combinations. The laboratory must endeavor to precisely duplicate conditions. Altitude chambers at Western Gear Corporation (as shown in the photo at lower right) can carry the test part to the extremes of altitude beyond the reaches of piloted flight up to and in excess of 90,000 ft. Temperatures must be duplicated far below those normally encountered by present day military craft. Tests have been run at Western Gear as low as –300° F.

The salt spray of the sea and the steaming humidity of the jungle as well as the wind and dust of the desert are being duplicated daily in our block-long test laboratory. The tremendous speeds as well as the necessity for the utmost in control produce forces in any direction which are simulated in Western Gear centrifuges in excess of 100 times the normal weight of the part. Studies of the reaction to shock loadings are duplicated in our laboratory by impact tests often running in excess of 200 G's.

The effects of wind, sand, dust, rain, sunshine, snow, heat, cold, vibration, impact, chemicals, lubricants and materials must be evaluated while constantly striving to increase load carrying ability, serviceability and reliability of products. Extensive testing is required to assure that no possible condition has been overlooked which may cause a malfunction. An example of a test stand setup to check the operational characteristics for testing linear actuators is shown at upper left. The interrelation of magnetism, electricity, gravity, vibrations, forces, materials and chemicals under environmental conditions often poses the necessity of multitudes of carefully controlled, precisely measured tests.

Western Gear engineering recognizes these very necessary elements. Therefore, in our block-long testing laboratory the most modern equipment is provided to prove design concepts. Thus meticulous attention to perfection has made Western Gear the leader in the field of aircraft gearing and systems design. Why not let us assist you in your next power transmission problem? Western Gear Corporation, General Offices, P.O. Box 182, Lynwood, California.



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COVER: XF-104, prototype of Lockheed F-104A, has flown at Mach 1.8 powered by Curtiss-Wright J65 with afterburner. Starfighter with more powerful General Electric J79 is reported to have reached speeds of Mach 2 and above. For design details and full picture coverage of F-104, see p. 34.

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Tests like this have helped make B. F. Goodrich first with the Dimpled tread, first with the Tubeless Tire, first with the new ultra-high-speed military tire that lands at speeds over 300 mph.

Recent airline comparison tests show that the B. F. Goodrich Dimpled tread outwears other leading brands. That's because a more uniform layer of tread rubber gives greater protection against tread cutting, better tread load distribution. Result: more landings before recapping.

And B. F. Goodrich Tubeless Tires make greater payloads possible. One airline reduced weight as much as 120 lbs. per plane under regular tires and tubes. Tubeless Tires save time and money in warehousing and maintenance, too.

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EDITORIAL

Revamping Our Airport Structure

Civil and military aviation face a tremendous problem in revising the airport structure in this country to meet the new problems created by the twin requirements of handling an unprecedented volume of airline and business-flying traffic and of providing an adequate base for the air defense of the North American continent and the long-range striking force of the Strategic Air Command.

The fact that future air traffic operating on these diverse civil and military missions must be handled by an integrated air traffic control system geared to the 500-1,400 mph. speeds of modern aircraft is now generally recognized, and initial steps towards effective action on this problem are under way. However, the problem of providing the proper ground facilities for the heavy volume of future military and civil aircraft movements is still only dimly perceived by the legislators and taxpayers who will be asked to support an airport construction and modernization program of unprecedented size and scope.

New Pattern Required

There are plenty of airports in this country, but few of them now fit the future requirements of military and civil aircraft operations. In the military field, most of the airports built during World War II were training bases located primarily in the South and Southwest where flying weather is best. The locations of these fields does not fit the current military problem of deploying an air defense force in areas where it can best protect the vital industrial complexes and communications centers of the United States and Canada.

Nor does the pattern of World War II fields fit the requirements of basing Strategic Air Command bombers where they offer the least vulnerable targets to long-range enemy air or missile strikes and the best position from which to launch an intercontinental counterblow. As the political threat to Strategic Air Command bases in the Middle East, North Africa, Iceland and Europe increases, the necessity for a well-dispersed network of domestic bases becomes more acute.

Never before has either the USAF or Naval aviation faced the problem of building air bases to sustain combat operations from the North American continent. The USAF is now spending about $1 billion annually on new air base construction, much of it in this country, and the lack of domestic bases is increasing the vulnerability of the Strategic Air Command to surprise attack. In all the public furor over long-range bombers, guided missiles and supersonic fighters, the job of providing adequate bases and facilities from which to operate, maintain and supply them has been generally overlooked.

Civil aviation also is bursting out of an airport pattern that has not changed essentially since World War II. There have been some magnificent new air terminals constructed in recent years at San Francisco, Seattle, Wichita, Milwaukee, Pittsburgh and St. Louis to name a few, but such major traffic hubs as Los Angeles and New York still offer passenger facilities that belong in the tri-motor days of air travel. In addition to the runway and ramp problems of aircraft design for jet transports, Charles J. Lowen, Civil Aeronautics Administrator, recently pointed out the strain that will be imposed on current-type passenger facilities by dumping loads of 120 to 150 travelers into a terminal on a single flight. Everything from lavatories to ticket counters and taxi service will have to be radically revamped to handle this unprecedented scale of peak loads.

Fortunately, the Federal Airport Act is now in a much more flexible shape, thanks to the legislative bulldogging of Senator Warren Magnuson (D.-Wash.). The Civil Aeronautics Administration is now able to plan for three years in advance on its airport aid and to promote a more realistic program. Mr. Lowen cited statistics showing that local sponsors of civil-airport projects will have available funds totalling $247 million through Fiscal 1959 with which to match an estimated federal financing of $232 million.

STOL May Provide Answer

However, as is so common in aviation, the rapid pace of technological progress may soon invalidate many of the current trends in airport planning. In an effort to avoid the inevitability of increasing miles of immobile concrete runways, inventive genius already is hard at work on new types of aircraft that will takeoff and land at angles approaching the vertical and may not need much more area than an oversized helicopter landing pad. Although the appearance of these revolutionary craft is certain, the time at which they will make their practical appearance is just as uncertain. This perplexing uncertainty poses one of the airport planners toughest headaches.

Whatever the future holds in the way of revolutionary aircraft it is certain that adequate long-range planning for airports and other ground facilities for both civil and military air fleets is just as vital as the effort now being expended on developing new types of aircraft.

—Robert Hotz

TITANIUM helps the Voodoo work its magic...

McDonnell's new F-101 Voodoo, a supersonic long-range strategic fighter capable of delivering atomic weapons, depends upon REM-CRU titanium for vital parts . . . just as do most other advanced-type aircraft.

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WHO'S WHERE

In the Front Office

Dr. E. R. Piore, vice president, Avco Manufacturing Corp., elected to the firm's board of directors.

Robert B. Murray, Jr., vice president, and **A. J. Kelly**, vice president-Europe, Pan American World Airways.

John M. Schaeffer, a director, Vertol Aircraft Corp. (formerly Piasecki), Morton, Pa.

K. J. Luplow, director, European office, Transport Division, Boeing Airplane Co., Seattle, Wash.

Will W. White, vice president and consultant, aircraft petroleum products, Esso Research & Engineering Co., New York, N. Y.

Frederick R. Merritt, administrative assistant to vice president-sales, Riddle Airlines.

Edward J. Odlum, senior vice president, Kaman Aircraft Corp., Bloomfield, Conn. Also: **Charles Kirchner**, vice president-industrial and public relation; **Edward G. Conway**, vice president-works manager; **John O. Emmerson**, vice president-chief engineer.

Honors and Elections

Lt. Col. Robert R. Scott, USAF, and Republic Aviation Corp., Farmingdale, N. Y., have been awarded a certificate by the Federation Aeronautique Internationale in recognition of the nonstop speed record from Los Angeles, Calif., to New York set by Scott in an F-84F Thunderstreak on March 9, 1955. Scott flew 2,463.92 statute-miles in 3 hr. 46 min. 33 sec. at an average speed of 652 mph.

Roger M. Kyes, former Deputy Secretary of Defense, has been given the Air Force's Exceptional Service Award. Presentation was made by USAF Secretary **Donald A. Quarles.**

Irving Pinkel, Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, Ohio, has received the first Laura Taber Barbour Air Safety Award, from Flight Safety Foundation, N. Y., for development of a system to suppress crash fires. Also honored were his colleagues, **Dugald O. Black, Gerard J. Pesman** and **G. Merritt Preston.**

Changes

W. R. Rhoads, director of Georgia nuclear aircraft test laboratories to be operated for USAF by Lockheed Aircraft Corp. near Dawsonville, Ga.

Charles H. Hurkamp and **Randell C. Smith**, chief of advanced design and chief of technical engineering respectively, Fairchild Aircraft Division, Hagerstown, Md.

Donald S. Conrad, chief installation engineer, Pratt & Whitney Aircraft, Division of United Aircraft Corp., E. Hartford, Conn.

William A. Clegern, manager-marketing, General Electric Co.'s Jet Engine Department, Cincinnati, Ohio.

Preble Staver, aide to the president, Air Transport Assn., formerly a transport editor, Aviation Week.

INDUSTRY OBSERVER

►Martin's second P6M is expected to make its first flight this week. Meanwhile, a full report on the mid-air destruction of the first airplane is complete. Approximately 80% of the airplane was recovered, and the cause of the accident has been narrowed to a group of possibilities. Engine failure is not one.

►Navaho test vehicle has been successfully fired from Patrick AFB, Fla., test range in flights to obtain aerodynamic and structural data for incorporation in the development program of the North American intercontinental missile. Test vehicle's is turbojet powered. Ultimate version of the Navaho will be powered by a ramjet and rocket combination.

►Hypersonic test vehicle has been developed by the Wright Air Development Center and the Aerophysics Development Corp. as a free-flight research tool.

►Successful experimental launchings of Boeing's IM-99 Bomarc long-range interceptor guided missile have been made from the Air Force Missile Test Center at Patrick AFB, Fla.

►Superior performance of the already-in-production Convair F-102A has sidetracked Air Force plans for the development of Republic's XF-103 as an all-weather interceptor. The prototype aircraft is now being utilized as an experimental weapon system and it is in the ground test stage at the present time.

►Hughes Aircraft's Falcon missile has been successfully fired from the Convair F-102A during extensive armament tests to determine the supersonic interceptor's combat capabilities. USAF says the tests indicated the aircraft's capabilities would be "satisfactory."

►Radioplane's XQ-4 target drone has achieved speeds in excess of Mach 1 during tests of its recovery system.

►B. F. Goodrich Co. has produced inflatable rubber wing surfaces for the Air Research and Development Command designed to reduce takeoff and landing speeds and distances. In successful tests with the F-84F, the leading edge of the wing was covered with a rubber surface, which, when air is pumped in, bulges up to permit smoother airflow over the wing.

►Air Force wants an incipient stall warning device for gas turbine engines that would enable jet fighters to accelerate rapidly at extreme altitudes without surging their powerplants to destruction. The Power Plant Laboratory at ARDC's Wright Air Development Center would like industry to cooperate by trading information in search for a solution. Westinghouse suggests one solution may be a fast response hot-wire anemometer that would open the jet nozzle whenever surging was imminent.

►Fairchild Aircraft Division, Hagerstown, Md., will construct a prototype of a four-jet utility transport with its own funds in hopes of stimulating executive and feeder-airline purchases. If enough orders are received to place the aircraft in actual production, it will be powered by Fairchild's 2,000-lb.-thrust J83 turbojets.

►Vertol Aircraft Corp.'s vertical-takeoff design for the Navy will be propeller-lifted, tilt-wing model.

►Coleman Engineering Co., Inc., will attempt to drive a rocket test sled at Mach 2 in connection with its research on seat ejection and other escape factors. Work at lower speeds is being done now at Hurricane Mesa in Utah under USAF contract.

►Fairchild Aircraft has developed a wheel-ski combination for USAF's C-123 assault transport. It will be ready for evaluation tests this summer. Requirement for the dual-purpose landing gear originated with Northeast Air Command.

Over a million airline hours of turbo-prop Viscount experience will be built into the Viscount 810-840.

the new 400 mph turbo-prop

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designed for greater profits and economy

The Viscount 810 • 840 is designed to cruise up to 400 miles an hour at 20,000 feet. Carrying up to 70 passengers, it will be the ideal aircraft for medium-haul, high-density routes. Higher speed and enlarged capacity are combined with greater engine economy and relatively low first cost to give the Viscount 810 • 840 its unique advantages. Powered by four new Rolls-Royce Dart R. Da. 7 or R. Da. 8 turbo-prop engines, the new Vickers Viscount 810 • 840 will be put into service by Continental Airlines in 1958. By then Vickers Viscount aircraft will have amassed more than a million hours of flying experience.

Behind the new Viscount 810 • 840 stands the great name of the Vickers Group—internationally famous as makers of aircraft, ships, industrial machinery and precision equipment.

United States Representative: Christopher Clarkson, 10 Rockefeller Plaza, New York 20, N. Y.

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Washington Roundup

Publicity Vs. Security

The Senate Subcommittee evaluating U. S. airpower began its public hearings (see p. 40) with Democratic Sen. Stuart Symington (Mo.), chairman, emphasizing the need for publicity, and Republican Sen. James Duff (Pa.), emphasizing the need for security.

Symington: "If censorship bars the citizen from access to necessary facts and expert opinion, his right freely to speak, freely to publish, and freely to debate the grave and far-reaching problems incident to national defense become but empty and useless legalisms.

"Only a strong and clear showing of injury to the national defense will justify the incalculable damage which can result from the people being forced to act in ignorance on matters which will determine their freedom.

"It is a fact that in a free society, censorship per se can constitute grave danger to national security. . . ."

Duff: "One point which I want to make with all the force I can muster . . . and that is what is involved here is the security of the nation. In our system of government, the people must be told the facts. I strongly believe the American people are entitled to them. At the same time, the Soviet intelligence forces must not be assisted by any carelessness on the part of either the subcommittee or witnesses who appear before it. Therefore, it is my earnest request that those charged with maintaining our nation's military security be given the job of determining what military and technical matter should not be publicly revealed in the course of these hearings. In my opinion, this subcommittee should avail itself of the guidance of those in our military establishment who are skilled in evaluating what facts should be kept secret so as not to assist the enemy."

Later, Vice Adm. Arthur Davis, (USN, ret.) was appointed by Secretary of Defense Charles E. Wilson to review executive hearings of the Symington Subcommittee for public release. Symington approved the appointment, saying he understood that Adm. Davis did a "fine job" of reviewing the Senate hearings on the firing of Gen. Douglas MacArthur in 1951. Symington said he thought it better that an Air Force officer not be assigned the job since the Air Force is deeply involved in the subcommittee's investigation.

Information Probe

House Government Information Subcommittee, headed by Rep. John E. Moss (D.-Calif.), will hold public hearings around the middle of May on Defense Department's information policies. Inquiry will include specific complaints of newsmen charging the withholding of information. R. Karl Honaman, former Deputy Assistant Secretary of Defense for Public Affairs, told the subcommittee last January he knew of no instance where requested information had not been supplied, "except where such information in the opinion of responsible persons was considered of a nature which would jeopardize the security of our country or would violate statutes or directives of higher authority."

Late this week the subcommittee will question officials of Commerce Department's Bureau of Foreign Commerce about control over the export of technical data. Under one regulation, scientists mailing unclassified scientific and educational technical data to foreign colleagues are required to have the envelope stamped: "Export Control of Technical Data. General License GTDS (General Technical Data, Scientific). Validated Export License not required." Scientists have complained to subcommittee that this kind of negative regulation, apparently unenforceable, is "asinine." They say colleagues overseas look on it as "a silly game of cops and robbers" on the government's part.

Supplemental Carriers

Air Coach Transport Assn. hopes to have a provision authorizing the Civil Aeronautics Board to award certificates for "supplemental" air service tagged onto legislation directing permanent certificates for Alaska and Hawaii carriers. ACTA wants it clarified that the Board has authority to certificate irregular operations.

CAB Confusion

Confusion and dissatisfaction over nominations to the Civil Aeronautics Board and the Civil Aeronautics Administration has spread from the Senate (AW Apr. 16, p. 25) to the House.

When CAB Member Joseph Adams appeared before the House Commerce Aviation Subcommittee last week, Chairman Oren Harris (D.-Ark.) asked if he were correct in addressing Mr. Adams as "Chairman." Member Adams explained that he was only acting chairman, and pointed out that the Board now has a new chairman—James R. Durfee. But he said Mr. Durfee has gone back to Wisconsin, where he was chairman of the state public utilities commission, to "clean off his desk." (Even with Durfee's nomination approved by the Senate, the Board is not up to strength. The nominations of G. Joseph Minetti as a CAB member and Charles J. Lowen as CAA administrator have been held up by Sen. A. S. Mike Monroney's Senate Commerce Aviation Subcommittee since last Jan. 9.)

Rep. Harris told Acting Chairman Adams he lamented the "running changes that have been part of the Board and CAA" recently and said he hoped that "one of these days," the Board will be able "to make a decision that will stand at least for a short while, anyway." (Hopeful note: Sen. Monroney, who has been abroad, was due to return to Washington today.)

Fight for Friendship

Sen. John Butler (R.-Md.), making a last fight to make Baltimore's Friendship Airport the alternative airport for Washington, D. C., argues that at least 23 major cities have airports more than 40 minutes travel time away. He made the point in an 8-page letter to Sen. Warren Magnuson (D.-Wash.), Chairman of the Commerce Committee. The committee is scheduled to vote this week on a report, approved by the Aviation Subcommittee headed by Sen. A. S. Mike Monroney (D.-Okla.), directing the Civil Aeronautics Administration to proceed with the construction of an alternate airport at Burke, Va. Some of the cities Butler lists: Chicago, St. Louis, Cincinnati, Cleveland, Fort Worth, Los Angeles, Minneapolis, New Orleans, Pittsburgh, St. Paul, San Francisco, Seattle, Toledo.

—Washington staff

PROTOTYPE F-104 carries tip-tanks in flight. It is powered by Curtiss-Wright J-65 engine. **F-104A will have GE J79.**

PLANFORM OF F-104A shows stubby, 7 ft. 6 in. wings. Covers overlap engine inlets and extend aft to the trailing edge of the national insignia circles.

USAF Shows

By Irving Stone

Palmdale, Calif.—The air superiority F-104A Starfighter was unveiled here last week and put through a startling demonstration of steep climbs, maneuvers and level flight that gave a clear clue to the plane's high performance capabilities. The fighter is described by Lockheed Aircraft Corp., its builder, as the world's fastest combat plane.

A very small configuration as fighters go, the F-104A probably has a gross weight of about 14,000 lb. Span is 21 ft. 11 in., length is 54 ft. 9 in. and height is 13 ft. 6 in.

No speed figures were revealed for the plane, but AVIATION WEEK has learned that the prototype XF-104, powered by a Wright J65 with afterburner, has flown at Mach 1.8 (1,192 mph. The production F-104A, powered by the much more powerful General Electric J79 and afterburner, obviously is capable of higher speed, reported to be better than Mach 2 (1,324).

The Starfighter has been ordered in quantity. First production models are scheduled for delivery to tactical units in the near future. Meanwhile, early production planes are being tested.

Lockheed also has developed a two-seat version, the F-104B, which has been ordered by the Air Force. The F-104B could double as a two-place tactical fighter and a trainer, but necessarily will carry less fuel because of the space the rear man will occupy.

One most unusual feature of the F-104A is the plane's very small, thin, straight wing, incorporating 10-deg. negative dihedral. Only dimension revealed for the wing panel is that it measures 7¼ ft. from fuselage side to tip.

Examination of the wing discloses that the root chord is approximately 10 ft. 6 in., tip chord about 4 ft. 10 in. Thickness of wing at center chord point of tip is approximately 1¾ in.

PRODUCTION STARFIGHTER closely resembles XF-104 except for spine running from cockpit canopy to vertical fin.

Unique Details of Lockheed Starfighter

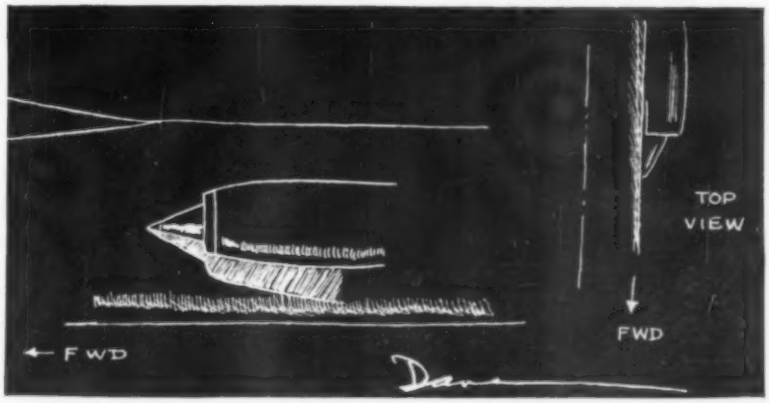
Flap length is 4 ft. 9 in., with inboard chord measuring 3 ft., while outboard chord is about 2 ft.

Aileron length is about 2 ft. 9 in., with inboard chord measuring 2 ft., and outboard chord about 1 ft. 6 in.

Leading edge flap, nosed with a sharp edged extrusion, has an inboard chord of approximately 1 ft. 6 in., outboard chord of about 9 in.

Engine inlets of F-104A were covered by metal shields. This covering conceals an external ramp or wedges mounted on the fuselage to cause a shock wave to form. This is an efficient method of getting air through the inlet at speeds above Mach 1.4.

C. L. "Kelly" Johnson, former chief engineer of Lockheed's California Divi-



RAMP OR WEDGE similar to this drawing is used at engine inlet to create shock wave and get air inside at Mach numbers above 1.4 on the F-104A.

'RAZOR' EDGE of very thin F-104 wing and the high mounted horizontal stabilizer are shown here.

sion, and now vice-president for research and development, revealed these highlights about the wing and other design features:

• **Wings are short** because the speed regime in which it operates, coupled with its high thrust-to-weight ratio, makes the low aspect ratio necessary. Also, to make the wing thin, it had to be short.

• **Straight, thin wing** develops high lifts at low angles of attack. No plane flying today, even research craft, has a wing as thin as the F-104's.

• **Radius of leading edge** surfaces of the wing (and tail surface) is .016 in., which makes it difficult for ice to accumulate.

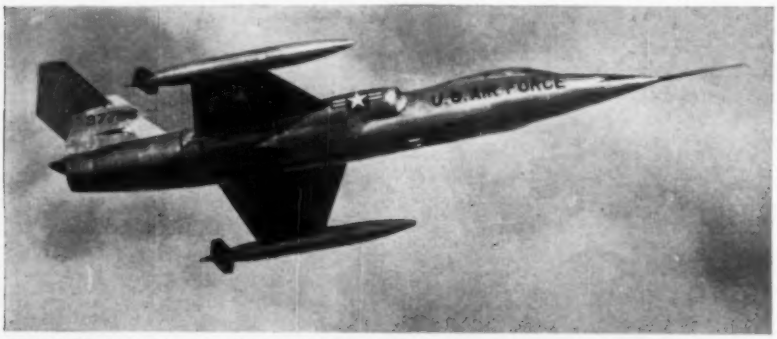
The plane's speed also creates a thermal rise to take care of any ice forming on the basic airplane surfaces.

• **Negative dihedral** is incorporated because of the combined effects of having a wing panel that extends only about 7½ ft. from the fuselage and a tail fin that reaches almost the same distance vertically. As a result, deflection of the rudder acts like an aileron and, to compensate for the roll from the vertical tail, negative dihedral is used.

• **The F-104 is designed** essentially symmetrical about the horizontal and vertical axes. This results in a mid-wing plane, affording 12% less drag than would be obtained with a low-wing design.

• **Movable, horizontal stabilizer** is set high on the tail fin to increase the effectiveness of the vertical tail by serving as an end plate. This position also avoids the downwash effects of the low-aspect-ratio wing. Effectiveness of the F-104 vertical tail is about twice that of a normal vertical tail.

• **Downward ejection seat** was incorporated in the Starfighter, because at the high flight speeds the plane can attain, it is safer to project the pilot downward so he does not run the risk of hitting the tail. Downward ejection gives a simpler canopy and better cockpit design.



PROTOTYPE F-104 uses inlets with boundary-layer separators to feed its J65.

PRODUCTION F-104A has high fineness ratio and excellent cross-section area distribution.

THIN WINGS far back make F-104 aerodynamics conform to principles of area rule.

Ejection Sequence

For ejection, the pilot pulls a handle to start an automatic chain of events:

(1) Cockpit is depressurized, and stick pops forward and out of the way.

(2) Parachute shoulder harness snaps onto pilot, his legs are pulled close to the body by straps, and ankle clamps hold the feet in place.

(3) An explosive cartridge releases the escape hatch and jettisons the seat downward.

(4) Pilot's seat belt unsnaps, freeing him from seat.

(5) At present altitude the chute opens.

If seat fails to eject, a pull on a handle will drop the seat out of the plane. In this case, the seat might skid along the bottom of the fuselage.

Commenting on ejection capsules, Johnson said, "We have carefully studied the ejection capsule approach to pilot ejection and believe that it actually jeopardizes the man to an unacceptable degree. I personally am of the opinion that there will be more accidents due to poor control connections to the pod than there will be 'saves' . . ."

Easy Access

Other design features of the F-104A include the use of boundary layer control. Engine bleed air is directed over the flap leading edge for BLC during takeoff and landing.

Flap on the wing's leading edge cuts down on the plane's takeoff run. It also

reduces landing speed, which is reported to be 120 to 130 knots.

Large engine access door, on bottom of fuselage, serves a double function by supporting most of the plane's hydraulic equipment, thus facilitating servicing.

Dive brakes are located on the side of the fuselage, just aft of the wing trailing edge.

Just forward of, and below, the air intake on the right side of the fuselage, there is a ram air turbine which can be dropped into the airstream to provide a drive for emergency hydraulic and electrical services.

Below the cockpit on the left side of the fuselage is a gun port for a 20-mm. cannon.

Main landing gear as well as nose gear, retracts forward into the fuselage. Main landing gear wheels rotate for flat positioning.

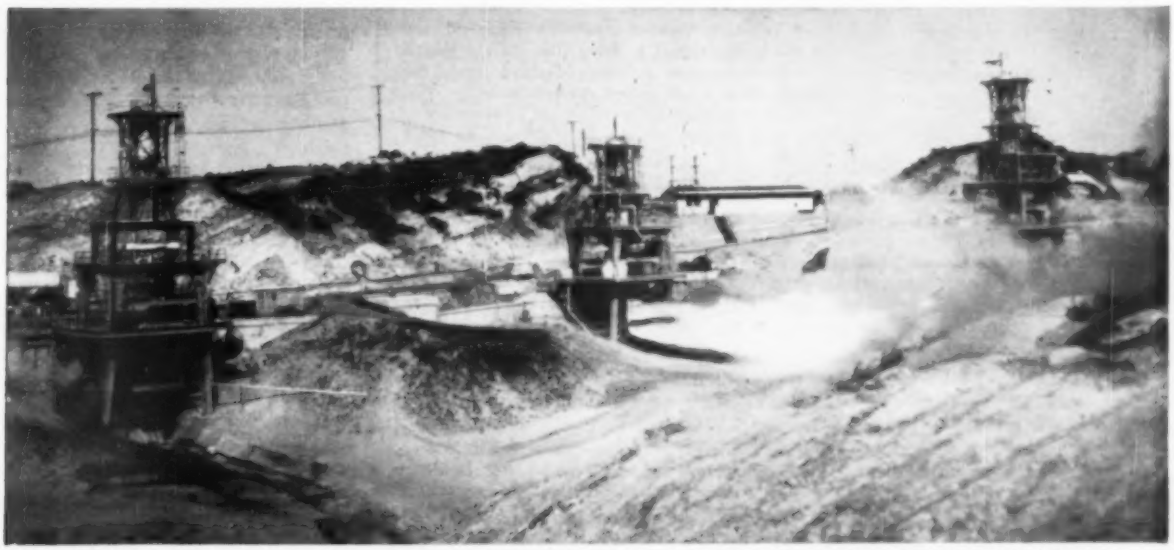
No Honeycomb

Future versions of the F-104 will exploit aluminum alloys fully, before any switch is made to titanium alloys. Now, only portions of the latter material are used in the exhaust section of the plane.

No honeycomb material is used in the F-104A.

In addition to jettisonable tiptanks which fit over the wing tips, provision is made for attachment of underwing pylon tanks if needed for extra fuel.

It is claimed that the General Electric J79, powerplant for the Starfighter, can produce more thrust per pound of engine weight than any other engine in its power class. No thrust figures have been revealed, but the engine is believed to develop a 12,000 lb.-thrust. At top speed, the engine with afterburner develops half of its thrust as a ramjet. The J79 employs variable stator blades to obtain maximum efficiency for various flight conditions.



THREE TEST STANDS for testing rocket engines for guided missiles at North American's Rocketdyne Propulsion field laboratory.

Atlas Engine Is Fired by Rocketdyne

By Richard Sweeney

Canoga Park, Calif.—Rocketdyne Division of North American Aviation last week opened the gates of its field propulsion laboratory in the Santa Susana Mountains near Los Angeles and fired some of the most powerful rocket engines in existence today.

The tour covered a control center for a typical set of three test stands, a components test laboratory and a typical firing at the 1,600 acre mountain-top site.

Main event for visitors was the firing of a sustainer chamber for an Atlas ICBM. Witnessed from 350 yards away, it was fired from a horizontal test stand into free air. Most firings conducted from vertical test stands into a blast deflector.

A complete Atlas powerplant consists of three rocket chambers: the sustainer chamber developing 135,000 lb. thrust and two 100,000-lb. chambers. The latter are mounted on either side of the sustainer chamber and will drop off part way through the missile's powered flight.

The sustainer alone will power the Atlas during the final stages of its full 180 sec. engine run.

Being fired, during the day were a three-chamber Navaho missile engine, a powerplant for the Douglas Thor IRBM, a complete three-chamber Atlas engine and a Redstone missile engine. All firings, including the demonstration for newsmen were part of regularly scheduled tests.

Control Center

In the control center, direct recording equipment for exact parameters of pressure, temperature and time were shown, as well as the 26-channel oscillographs capable of 2,000 cps. for transcribing transient information of buildup and decay rates and limits of pressure, temperature and strain. At Santa Susana, an IBM 704 digital computer is being installed for greater speed in data reduction of oscillograph recordings as well as computations by test engineers.

Development Groups

Operating at Santa Susana are the engineering test and rocket powerplant development groups. Engineering test is primarily concerned with exact testing techniques, equipment and procedures while the development group is interested in the engines being tested. The development group sets up test requirements; the test group carries them out.

At Santa Susana, seven sets of test stands are now in existence. More are under design and construction, as is a production plant for liquid oxygen. Presently, a contractor has to truck in "lox," as it is called, by a steep, narrow and twisting road.

All but one of the test stands are

Rockets Will Get 'Space' Tests

Santa Susana, Calif.—A space chamber to test lightoffs of rocket motors in space will be incorporated in the Delta Area, a new addition to the five test areas at North American Aviation's Rocketdyne Division.

Engineers have calculated firing chamber parameters for zero pressure at the nozzle, but ignition in a vacuum remains to be tested.

Undoubtedly following the ignition test chamber will be an aspirator-type chamber for full-fledged rocket engine runs in total vacuums of outer space.

The present setup, part of a stand being designed by Daniel, Mann, Johnson and Mendenhall, will be a vertical chamber about 20 ft. long, 6 to 8 ft. in diameter. Only the nozzle end of the engine need be in the vacuum chamber, since the remainder of the engine and fuel system are such that outside pressure means nothing to their operation, although temperature can affect operation of the gas generator and turbopump.

Present test stands are four-legged steel structures. In the new stand, a separate set of two legs is added in front. Between this and two legs of the main part of the stand, is hung the North American-designed-and-built low pressure chamber.

The metal chamber will employ high-capacity vacuum pumps to insure extreme low pressures for engine start tests. Once the engine is firing, the current design looks as if the exhaust will automatically open into a free-air discharge since the chamber is not large enough to accommodate a full rocket exhaust flame.

Next step will be creation of a huge low-pressure chamber, larger than anything ever before attempted, in which the entire engine run can be conducted in outer space conditions.

vertical, with engines firing toward the ground. Inch-thick steel plate, water-cooled, is employed as blast deflectors on the stands. Deflectors also help to reduce the noise, although pressure waves still present a problem as they travel over mountain lips and land on communities sometimes miles away from the test area.

Rocketdyne now is testing engines and components of more than 350,000 lb. thrust. Stands currently under design and development will hold engines of up to a million pounds of thrust.

The Santa Susana facility is composed of five areas, two belonging to North American and three to the Air Force but all operated by North American. The areas are Bowl and Area 1, of NAA; Alpha, Bravo and Coca belonging to USAF.

One of the most important parts of Santa Susana is the components test laboratory, where newsmen saw a test conducted on a gas generator. The exhaust was lighted off. A critical part of any rocket engine is the generator, usually operated either by decomposing hydrogen peroxide or main rocket propellant, and supplying power for the turbine pump which must deliver upwards of 1,800 lb. per second of fuel and oxidizer into rocket engine firing chambers. The generators, about the size of a football or smaller, deliver more horsepower than a locomotive.

The Rocketdyne Division has several plants spread over the Los Angeles area. Main Rocketdyne plant is located in this small community 35 mi. northwest of Los Angeles. Here, eventually, will be located the engineering and production for rocket engines, now spread over several facilities: engineering in Canoga Park, engine machine shop work in Beverly Hills, assembly in the small San Fernando Valley plant at Deering, plus sustaining operations at a southwest Los Angeles site.

On the Canoga Park North American property, covering 40 acres and worth $3 million, are also located the headquarters for the NAA Atomics International Division. This division also has an area in Santa Susana, where a reactor is being installed to generate electricity and for other industrial purposes.

One of Santa Susana's biggest problems is noise which bounces over the lip of the mountaintop site and strikes communities in Simi Valley, San Fernando Valley and sometimes crosses another mountain range and bounces into southwest Los Angeles 40 mi. away. Also bothersome are shock waves, such as those that are generated when a complete Atlas engine is fired.

Construction of test stand areas is such that groups of stands are placed in small hollows surrounded by rocks, with a control center and support facilities. The stands themselves are steel, anchored into bedrock by concrete, with variations possible in what engine can be mounted and methods of test employed.

Design of Moon Rocket Now Believed Possible

Philadelphia—The state of art is ready now to start designing a research rocket to the moon, George H. Clement, senior engineer Rand Corporation, last week told a Franklin Institute Symposium on rockets for peace.

Rigorous solution of classical equations of celestial mechanics on Rand's Johniac computer indicate that a hundred pound payload split half and half between scientific instruments and a one watt telemetering transmitter could be safely landed on the moon. Project would need a three stage rocket which would have a 950,000 pound starting weight and reach 35,000 feet per second velocity at 350 miles above the earth's surface.

Third stage would spin at one revolution per second for stability in space and would carry an arresting rocket to lower payload safely on to moon surface.

The trip would take approximately two and one-third days.

Biggest problem is accurate control of initial trajectory and speed. For example, if speed at 350 miles reference point above earth was 85 feet per second too great or .5 deg. off in aim, payload would miss the moon and return to the earth.

Clement expects that although payload would approach moon at 9,000 ft. per second before slowdown rocket is fired, the lack of atmosphere around moon would preclude aerodynamic heating.

John C. Cooper, legal advisor of the International Air Transport Association, stressed that, although at present the outlook for peaceful development of space is not good, it will be better if industry gives government a much needed civilian boost towards a declaration on the freedom of space.

YH-16 Cancelled

Washington—Vertol Aircraft Corporation's YH-16 helicopter project has been cancelled. Action was taken by USAF upon withdrawal of financial support by the Army.

Program for development of the world's largest transport helicopter is nearly five years old, and two prototypes have been built. One of them crashed and burned during a test flight late last year. The terminated contract called for conversion of the second helicopter to turbine power with Allison T-56 engines.

The action was attributed by the Army to changing requirements and followed closely the award of two research and development contracts for STOL aircraft to Fairchild Aircraft Division and Doak Aircraft Co. (AW April 16, p. 34).

Informed sources estimate that the backlog of Vertol, formerly Piasecki Helicopter Corp., has been cut $3.5 million by the cancellation. Early this year the company reported its backlog was $150 million, most of this in orders for the H-21, a 16-passenger helicopter.

The YH-16 project was started with USAF funds, later supported by the Army. Total invested in the program probably is in excess of $20 million.

Gen. Power Warns:

Budget Policy Threatens Airpower Lead

Washington—The United States will lose its technological supremacy over Russia unless it abandons its constant budget-level policy for research and development and matches this type of expenditure to the rapidly-expanding requirements of technical progress, Lt. Gen. Thomas S. Power, chief of the Air Research and Development Command, warned the Aviation Writers Association here last week.

Gen. Power emphasized that the rate of technological progress has not leveled off but is increasing along a geometric progression of constantly-increasing steepness that matches the basic growth curves for the general progress of civilization.

"An increasing rate of progress," he said, "goes hand in hand with increasing growth of complexity and increasing efforts required to achieve equal units of progress."

"This means that one year's budget for research and development cannot buy an equal amount during the following year or years thereafter. Therefore, research and development appropriations must be matched to the expanding requirements of technological progress. Unless we can see our way clear to do so, we will lose our technological superiority to the less budget-hampered Russians."

R & D Task

Gen. Power said the United States now has the dominant position in airpower but will continue to hold it only if a well-planned, vigorous research-and-development policy is pushed utilizing all the advantages offered by a free and competitive civilization. He warned against trying to imitate Russian methods even though they appear to be more efficient.

"Obviously," he said, "we cannot adopt Communist principles of operation because in so doing we would destroy exactly what we are fighting to preserve. We must outperform the Russians through vastly superior management techniques and methods of operation that are possible in our type of civilization."

In addition to an expanding research-and-development budget that will move along the natural growth curve of this country, Gen. Power recommended the following basis for a sound technological program:

- **Increased expenditures** on research and development by private industry.
- **Increased emphasis** by private industry in providing post-graduate technical education for its employes.
- **Greater use** of the atmosphere of academic and scientific freedom in universities and scientific institutions that can be far more conducive to creative thinking than the regimentation and political pressure of a Communist regime.
- **More effective industry-military** relations in the use of basic new knowledge to develop new aerial weapon systems in the shortest possible time.

Industry's Burden

"We may become economically unable to keep up with the accelerating pace of the race for technological supremacy unless industry is not only our partner and teammate but agrees to assume a far greater share of the research and development burden than it does now. If the military can draw to an increasing extent on the results of civilian sponsored research and development, instead of the other way around, I am confident we can stay ahead in the airpower race indefinitely without impairing the standard and stability of our economy.

Citing the Air Force program to provide its officers with advanced technical training, Gen. Power said private industry should be encouraged to finance graduate and post-graduate technical training for its promising employes "on a far greater scale than is being done by a few progressive companies."

"I believe that an all-out effort along these lines by industry would not only prove a great boon to industry itself but would help this country to keep pace with the Soviets in the race for superior brain power."

University Aid Sought

Gen. Power emphasized that the Air Research and Development Command was making strenuous efforts to tap the scientific manpower resources of universities through contracts let by its own Office of Scientific Research.

"We encourage research in the most diverse fields," he said, "even if no immediate military advantage should be apparent. The main purpose is to extend our basic knowledge which we believe will ultimately pay off in providing the basis for some radically new weapons five, 10 or 20 years hence."

In an attempt to radically cut the development cycle for new weapon systems, the Air Research and Development Command has adopted a new policy of major component or sub-system development. The new "state-of-the-art" principle as explained by General Power permits development of new

LT. GEN. THOMAS S. POWER

major components such as engine, fire control systems, missile guidance systems, etc., on the basis of the latest scientific advances without being "time tagged" for any specific weapon system.

This policy is expected to make available a large variety of readily-available and highly-advanced sub-systems to use when a new weapon-system development is planned and will cut down the length of lead time required to get the entire system operational.

Russian Progress

"We still have a long way to go before we can make effective use of this approach because we still permit crash programs to keep us too occupied to spend much time on weapons for the future." Power said.

"For this very reason," he added, "The Air Research and Development Command has initiated steps to form a long-range program planning every facet of our operations for many years ahead.

"Six long range planning committees have been appointed to cover such fields as guided missiles and space vehicles, aircraft, propulsion materials, electronics and aero-sciences."

Gen. Power emphasized that the Russians appear to be ahead of this country in some areas and are bound to soon catch up in many other vital areas unless we are prepared to meet their challenge.

The United States, he said, still has the dominant position in military airpower "at the moment" but will continue to maintain it only if all of the techniques and resources of a free, competitive society are vigorously and intelligently applied to our research and development effort.

Senate Subcommittee Begins Probe To Evaluate Soviet-U.S. Air Status

By Katherine Johnsen

Washington—The Senate Armed Services Subcommittee, established to evaluate the status of U. S. airpower and headed by Sen. Stuart Symington (D.-Mo.), the first Secretary of the Air Force, launched its public hearings last week with testimony by two World War II ground officers.

Both Gen. Walter Bedell Smith—who was chief of staff to Gen. Eisenhower during World War II, Ambassador to Russia (1946-49), chief of the Central Intelligence Agency (1950-53), and Under Secretary of State during the Truman Administration—and Gen. Omar Bradley—who was chairman of the Joint Chiefs of Staff during the Truman Administration—emphasized the need for military preparedness on the ground and on the sea, as well as in the air. They told the subcommittee that U. S. military power depends on "strength in being" and research and development effort—to assure the continuance of the strength in being.

Sen. Symington said the point in summoning the two prominent ground officers was "to acquaint the American public in general with the need of preparedness."

Scheduled to testify at the subcommittee's second public session were Adm. Robert Carney, former Chief of Naval Operations, and Gen. Carl Spaatz, former USAF Chief of Staff.

The Fundamental Question

In his introductory statement, Sen. Symington said the subcommittee's investigation "will be focused primarily upon one fundamental question—are the present and planned strengths of the U. S. Air Force adequate to preserve the peace through the deterrence of aggression."

Both the Army—from the standpoint of airlift and guided missiles—and the Navy—from the standpoint of airpower and guided missiles—will be involved in the subcommittee's investigation.

"We are determined that the investigation will be conducted objectively and impartially," Sen. Symington said. "We are determined that neither political partisanship, nor any views previously held on some of the subjects under study, shall be permitted to impede a full and fair investigation of all relevant facts, along with the gathering of expert and responsible opinions from the best qualified sources."

Sen. Symington, a persistent critic of the Administration's defense policies on guided missiles and airpower, has declined to challenge the administration since his appointment as chairman of the subcommittee. On the eve of the subcommittee's first hearing, however, Sen. Henry Jackson (D.-Wash.)—second ranking Democrat—declared that the Administration's recent request for a $547 million supplemental military appropriation—including $248 million for increasing B-52 production—amounted to "confessing that they're wrong."

Plan of Operation

Sen. Symington said the hearings will be divided into four phases:

- "**The first phase** will include witnesses eminently qualified to testify as to developments in the military situation since the end of World War II.
- "**The second phase** will have to do with an examination of the present and prospective airpower of the Communists. . . .
- "**The third phase** will be devoted to testimony about the present and prospective position of U. S. airpower with respect to all major elements which affect that power.
- "**The fourth and final phase** of the hearing will embrace an appraisal of the capability of our Air Force to discharge its mission in the light of what is known about the strength of the Communists."

Gen. Smith told the subcommittee that immediately after World War II, the U. S. realized the "excellence" of Russia's top-level scientists and engineers, but took the view that "below this thin crust there was a very great shortage." He said the U. S. underestimated Russia's ability to fill this gap. Although highly-trained German scientists were diverted to Russia after the war, Gen. Smith said he did not think Russian technological advances have been "dependent" on these.

"Whatever are the vital areas" of defense, Gen. Smith said, the U. S. "must, if possible keep ahead." But consideration also must be given to "a sound economy." Under questioning by Sen. Jackson, Gen. Smith said the possession of a 1,500-mile missile by the Russians would have a "very profound psychological effect" on this country's European allies.

Gen. Bradley predicted that the next all-out war would start with an attack on the U. S. He mentioned the alternative that a small war "could get out of hand." For this reason, he emphasized, the U. S. is "almost entirely" dependent on its military strength in being—Navy and ground forces as well as airpower.

Since the end of World War II, Gen. Bradley said, the Russians have "always showed up with something better than hoped—our pilots in Korea, for example, were surprised with the MiG." He said that the U. S. need not match the USSR "number for number" in defense forces, and should not risk "economic bankruptcy" in the defense effort.

Under questioning by Sen. Herman Welker (R.-Idaho), Gen. Bradley said Iceland's action in forcing abandonment of the USAF base there is evidence that Russia's propaganda "is beginning to have effect on the integrity of the North Atlantic Treaty Organization." He agreed with Welker that the action dictated greater emphasis by the U. S. on inter-continental bombers and guided missiles.

Quarles Promises Controls Revision

Washington—U. S. Air Force Secretary Donald A. Quarles last week told 20 aircraft industry executives that control clauses in procurement contracts will be revised where ever possible and necessary to achieve a balance between industry and USAF objectives.

A top-level conference, attended by more than a dozen presidents and board chairmen of major prime contractors, brought assurances that the USAF is ready and eager to give industry maximum latitude in its operations. The industry leaders had charged that the Air Force "sought excessive control over private aircraft firms."

Quarles told Aviation Week he has "every sympathy with the industry's point of view." However, he also made it clear that USAF "faces a lot of pressures to prevent abuses" and achieve economy.

He said Dudley Sharp, Assistant USAF Secretary for Materiel, and C. W. LaPierre, board chairman of Aircraft Industries Assn., will head a new study of the regulations, insuring AIA a voice and an opportunity to make suggestions. Quarles said the meeting uncovered no basic disagreement in philosophy between the USAF and the contractors.

LaPierre served as spokesman for the AIA group, aided by some of executives. In addition to Quarles and Sharp, USAF officials present included Maj. Gen. Thomas P. Gerrity, Assistant to the Deputy Chief of Staff, Materiel.

Sharp Says USAF Won't Wield Excessive Control Over Industry

By Claude Witze

Washington—Dudley C. Sharp, Assistant USAF Secretary for Materiel, said last week that the Air Force has no intention of assuming excessive control over aircraft industry operations. If such a tendency is "creeping in," Sharp said, it will be stopped.

Sharp gave his assurance to AVIATION WEEK almost on the eve of a Pentagon conference at which representatives of the Aircraft Industries Assn. protested a number of contract clauses. AIA charged, in a resolution presented to USAF Secretary Donald A. Quarles, that controls tend to limit the ability of management to exercise its own judgment (AW April 16, p. 26).

Sharp, however, emphasized his responsibility to the public and Congress.

"If there are instances where industrial performance is poor," he said, "we can be criticized for our stewardship. It is only for this reason that we must insist on monitoring the aircraft production program. There is no intent to interfere with their business."

On Executive Salaries

Sharp's viewpoint is illustrated by his stand on executive salaries. The USAF's request for information on this subject is one of the sources of industry irritation.

"You may ask," he says, "why we are so concerned with a problem such as this, which is a function of internal management. The reason is that salaries are largely reimbursed under our contracts.

"It is certainly not our purpose to control the internal management of individual companies who produce primarily for the government, but, on the other hand, we cannot ignore sudden salary increases which are obviously out of line."

Sharp said there have been cases where the Air Force has called attention to unwarranted raises, and its views have been accepted by aircraft companies without argument.

He added:

"This, we believe, we can and should do, and—in our opinion—this does not constitute an improper dictation to management of the manner in which it will conduct its business."

Production Controls

The assistant secretary indicated that industry will be asked to make suggestions on how the Air Force can meet its public obligations without undue interference with industry prerogatives. This would be a logical step, since industry already has the opportunity to comment on proposed procurement regulations before they are promulgated.

This is the current status of the proposed production control clauses now being protested by AIA. Still not finalized, Sharp believes the regulations, or something like it, is necessary for economy reasons.

He points out that information on production control is essential for the Air Force to meet satisfactorily its overall problem.

This involves such factors as industrial dispersion, mobilization, small-business interests and utilization of scattered skills and facilities. In addition, there is an obligation to conserve on the government's investment in plants and tooling.

Another specific cited by Sharp is the possibility that a prime contractor will overbuy from his subcontractors. If there is a change in a component, this can result in cancellations, and cancellations cost money. An overstocked item that runs into a cutback or engineering change is looked upon by Congressional critics as the responsibility of the Air Force.

On the subject of profits, Sharp says he is deeply concerned because "substantial reinvestment of profits reduces the facility and financing burden of the government."

Reinvestment Need

Again denying that the Air Force injects itself actively into corporate management, Sharp said, "We expect the aircraft companies to be prudent and conservative in their treatment of dividends, and we believe the record will show this to be the case."

The assistant secretary believes there is a growing trend towards greater investment of aircraft and engine-company profits in research and development facilities.

He said he has made recent visits to the General Electric plant at Evendale, Ohio; Wright Aeronautical's new research plant to Quehanna, Pa., and the Allison facility at Indianapolis. All represent investment of company funds.

He said there is a similar but not so marked a trend in the airframe industry. He made it clear that a company reinvesting its earnings in such programs will have that factor considered when the Air Force is studying its profit picture.

DUDLEY C. SHARP

Sharp gave a clear picture of the USAF approach to profit in a recent address before the National Security Industrial Assn. in which he said:

Profits Approach

"We do not attempt to establish the profit factor by formula. We believe that the profit allowance of each contract must be negotiated in relation to the value of the particular job to be done.

"We also encourage use of the profit factor in such manner as to induce the contractor to perform more efficiently than he otherwise might, by affording him an opportunity to earn more profit thereby.

"Since costs represent the greatest portion of price, use of the profit incentive to exert pressure on costs results in the greatest savings to the government.

"On the other hand, flat rates of profit, or preconceived percentages must be avoided, for, in the long run, such concepts tend to increase costs, penalize the efficient and reward the marginal producer.

"We consider that our incentive approach is responsible in great part for industry's cost reduction programs."

To AVIATION WEEK, Sharp added that sales volume is the only practical yardstick for measuring profit. Net worth, he said, is somewhat ridiculous and would get impossibly complicated in dealing with a prime contractor who has Navy and commercial business in addition to Air Force contracts.

"Sales can be used as a base line for measuring profits on a contract-by-contract basis," he said.

"On the other hand, net worth, which is determinable for only a specific point in time, and varies from day to day, is difficult if not impossible to use as a basis for determining profit allowance on a contract-by-contract basis."

News Digest

A $7.5-million 10-megawatt nuclear reactor will be built by Air Research & Development Command at Wright-Patterson AFB, Ohio. Design of the water-moderated, water-cooled reactor is scheduled for completion this month.

Missile-carrying McDonnell F3H-2M Demon is being evaluated. In addition to missiles, stowed under its wings, the F3H-2M retains Demon's standard armament of 20mm. cannon.

Six Fokker Friendship turboprop transports have been purchased by Trans-Australia Airways for $2.7 million. TAA reportedly is having difficulty disposing of its Convair 240 fleet, which it has replaced with Vickers Viscounts.

Two additional DC-6Bs are urgently wanted by Australian National Airways, which is pressing for import licenses and early deliveries.

Convair B-58 supersonic bomber powered-control system is being flight-tested by Convair-Ft. Worth pilots in a Northrop F-89 testbed.

Carrier evaluation trials have been passed by Chance Vought F8U Crusader, Grumman F11F-1 Tiger, Douglas A3D Skywarrior and Douglas F4D Skyray aboard the U.S.S. Forrestal.

Trainer contracts totaling $2.5 million have been awarded by the Navy to Bell Aircraft Corp.'s Helicopter Division, Ft. Worth, Tex., covering 24 three-place HTL-6 (47G) and 14 four-place HUL-1 (47J). Bell's orders for the HUL total 24, all but two slated for active service.

Gen. Lauris Norstad, air deputy to the Supreme Allied Commander, Europe has been appointed commander of North Atlantic Treaty Organization. The first air officer to command these forces, he succeeds U.S. Army Gen. Alfred Gruenther, who retired for "personal reasons."

Air Force Will Lease Transports to Airlines

Washington—The Air Force plans to lease five transports to qualified cargo carriers under a program approved last June by the Air Coordinating Committee.

The Air Force plan is similar to a recent Navy leasing program which made four aircraft available to commercial operators.

The Air Force planes include two C-118 (DC-6) transports and three C-54s. The Civil Aeronautics Board will make recommendations to the Air Force on which carriers should get the aircraft and what rates should be charged.

Under the plan, leases are limited to one year and the renting airline will have to be ready to return the plane in its original state immediately in case of a national emergency. The carrier also will have to furnish a crew for the returned aircraft for 30 days.

To be eligible for the program an airline must have new aircraft on order or place orders within 90 days after receiving an Air Force transport.

Operation of the leased transports is limited to the North American continent. The aircraft can be used for carrying cargo only, and they cannot be used in military charter or military contract operations.

Air Coach Transport Assn. objects to limitations in the program. ACTA says carriers should be allowed to carry passengers, operate overseas and use the aircraft on military work in order to balance their operations. The supplemental carriers feel the rules are too restricted for their use and work to the advantage of domestic cargo carriers.

New USAF Chief Scientist

Washington—Courtland D. Perkins, professor and chairman of the Department of Aeronautical Engineering at Princeton University, will become chief scientist of the U. S. Air Force this summer.

Dr. H. Guyford Stever, who has held the post for 18 months, will return to the Massachusetts Institute of Technology as associate dean of engineering.

Professor Perkins, an aeronautical engineer and a graduate of Swarthmore College and MIT, headed the stability-and-control unit of the Aircraft Laboratory at Wright Field during World War II. Since the war, he has served on the USAF Scientific Advisory Board, the National Advisory Committee for Aeronautics Aerodynamics Subcommittee and as editor for the Advisory Group for Aeronautical Research and Development (AGARD) Flight Test Panel. He has participated in research on airplane and missile stability, control and guidance and has written a textbook on applied aerodynamics. He is an Associate Fellow of the Institute for the Aeronautical Sciences, the Royal Aeronautical Society of Great Britain and the American Rocket Society.

DC-8 Simulator Sold To Douglas Aircraft

Binghamton—Link Aviation, Inc. sold its first civilian flight simulator last week to Douglas Aircraft Co. for the DC-8 jet airliner. Douglas will use the simulator to train its own pilots and the airlines which have ordered DC-8s.

Airlines, including KLM, SAS, Swissair, Pan American and United, are also considering DC-8 simulator purchases. One will announce its order for a Link unit this week.

Link has made simulator proposals to Boeing for the 707 series, to Lockheed for the Electra and to Convair for the Skylark.

The DC-8 simulators, costing over $1 million each, will provide weather radar simulation and includes a cockpit motion system similar to that used on its ME-1 twin-jet instrument trainer built for USAF.

Aircraft Backlog

Backlog of unfilled orders for complete aircraft, engines and propellers totaled $15.7 billion at the end of 1955, the Department of Commerce reports. This represents an increase of 6% from the backlog of orders at the end of the previous year.

Orders of military customers represented 83%.

Total net new orders received during 1955 amounted to $9.3 billion, representing 60% of the total backlog at the end of the year.

(All Figures in Millions of Dollars)

	Total	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
TOTAL	$9,394	$1,384	$2,032	$2,026	$3,952
Complete Aircraft and Parts	5,207	601	930	1,424	2,252
For U. S. Military	3,462	450	586	1,116	1,310
Other	1,745	151	344	308	942
Aircraft Engines and Parts	2,127	287	759	177	904
For U. S. Military	1,716	223	677	105	711
Other	411	64	82	72	193
Aircraft Propellers and Parts	77	14	24	16	23
For U. S. Military	57	17	14	8	18
Other	20	−3	10	8	5
Other Products and Services	1,983	482	319	409	773

Let Freedom Ring!

From the moment the *spirit of '76* was born with the *shot heard 'round the world* and proclaimed with the ringing of the Liberty Bell . . . sounds have played a vital part in our American freedom!

Today, the freedom of every man, woman and child of this nation is inseparably linked with another sound – the protective roar of great new jet aircraft like Convair's delta-wing supersonic F-102A all-weather Interceptor.

The modern minutemen of the U.S.A.F. Air Defense Command who fly these jet aircraft for your protection never relax their vigil. *Let Freedom Ring!*

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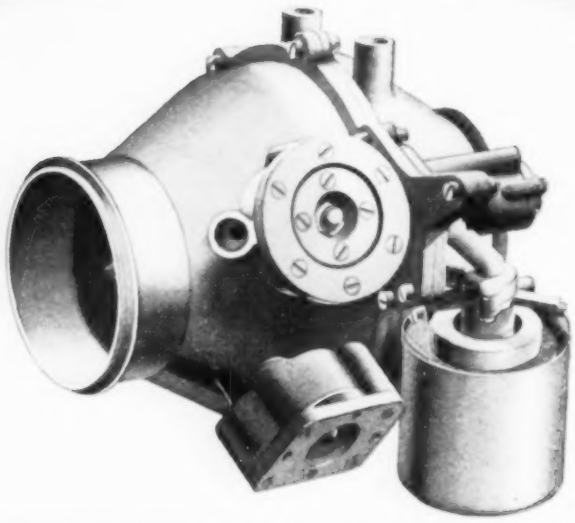

AIR PRESSURE REGULATOR AND FUEL TANK VENT VALVE

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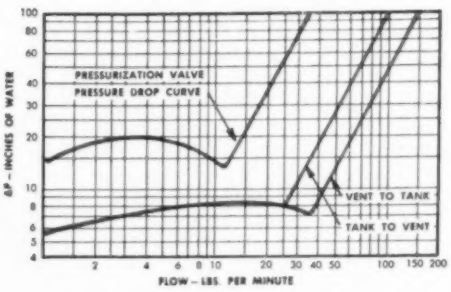
As part of an air pressure fuel transfer system, this SCHULZ designed valve will prevent venting of vapor outside of fuel tank until tank internal pressure exceeds 5 psig; permit air to enter the tank when pressure drops below atmospheric; with the vent inlet submerged in fuel, a float operated valve prevents the valve from venting outside the tank until the tank pressure exceeds 8 psig; maintains tank pressure at 5 psig by controlling the flow of pressurized air into the tank; prevents pressurized air from entering into the fuel tank when air or fuel is venting outside the tank. Temperature range from −65°F to 290°F.



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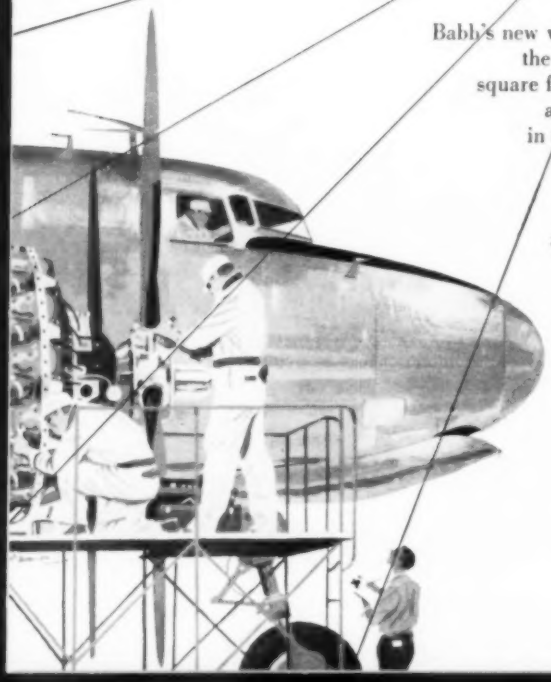

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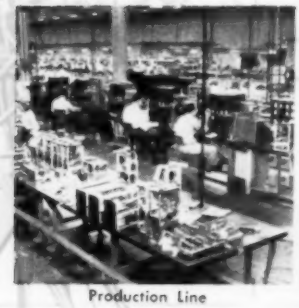
London, England; Paris, France; Brussels, Belgium;
Zurich, Switzerland; Rome, Italy; Damascus, Syria.

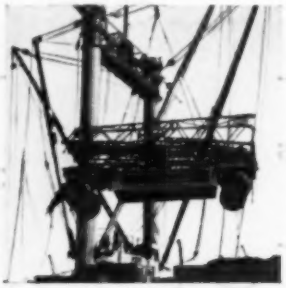
G-E MOBILE RADAR FOR OVERSEAS *From production line*

An extremely vital part of the defense net for the United States is the radar detection system of our allies in the NATO countries. The United States Air Force in its plan to reach out farther and farther for optimum early warning for our defense is currently installing modern radars in these countries. The FPS-6 Height Finder, a product of the HMEE* Department of General Electric, is a front line defender, since it is the most powerful of its kind in the world today. General Electric is proud of its association with our Air Force through the development and production phases of this and other defense radar systems. The actual photographs below typify the joint efforts of the Air Force and General Electric in the production, shipping, and installation of these electronic systems. The HMEE* Department of General Electric has a world-wide Product Service organization which is continuously available for emergency and routine maintenance of such complex electronics systems used by our Armed Forces.



Production Line

Sea Transport



Unloading at Port of Debarkation

Placement of Reflector

Radar Shelter Erection

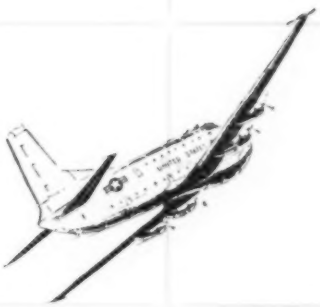
Final Shelter Adjustments

A LEADER IN SYSTEMS DEVELOPMENT AND

*HEAVY MILITARY ELECTRONIC

THE U.S. AIR FORCE...

to operation in Germany within 90 days

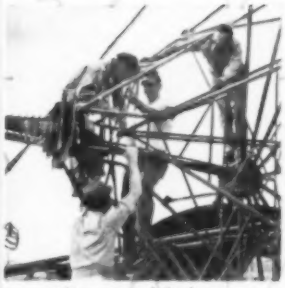


Engineers interested in a challenging opportunity write for booklet "New Horizons," General Electric Company, HMEE DEPT.* (5), Syracuse, N. Y.

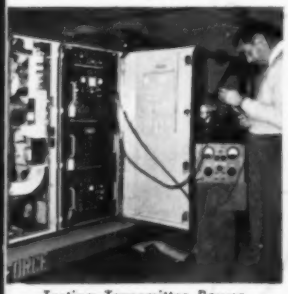
G. E. Field Representative Checking Convoy

Installation . . . Air Force and G. E. Cooperation

Antenna Erection



Alignment of Radar Horn Feed



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Final Systems Adjustments

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NORTH AMERICAN T-28C basic trainer approaches fantail of U.S.S. Tarawa on one of 28 landings it made in course of four-day trials.

THROTTLE CUT, the new trainer gets set to land. Major changes over earlier T-28s include arresting hook and barrier equipment.

T-28C Tests Its Sea Legs

TAILHOOK CATCHES Tarawa's deck wire, will stop T-28C short.

T-28C TAKEOFF shows plane poised over edge of carrier's flight deck.

shortest time between 2 points... is by BELL helicopter

WHEN Radio Materials Corporation of Chicago, manufacturers of electronic components, added a new plant 135 miles away in Attica, Ind., it solved an expansion problem but ran into a transportation problem.

Executives shuttling between the two facilities were losing valuable working hours enroute. Road travel meant a three or four hour trip and even when using the company's fixed wing airplane, the two hours by auto between plants and airports couldn't be overcome.

But Board Chairman Joseph F. Riley met the situation by adding to his traffic department one of Bell Aircraft's new three-place executive helicopters—the Model 47H BELLAIRUS.

Now Riley and his executives make the trip by helicopter from the roof or parking lot of one plant to the other—in 90 minutes or less. At a minimum, this will save an estimated 1000 expensive management hours a year. Equally important is that the helicopter service operates at the dictates of business—not the weather.

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RMC's RILEY SAYS "We are finding that just the possibility of a helicopter trip is creating an unexpected sales appeal to potential and existing customers. So you might say the Bell helicopter is a valuable addition to our sales force in addition to serving as a vital administrative tool."

Radio Materials Corporation's experience with the time and money saving features of Bell helicopters is typical. These helicopters provide safe and quick transportation at low initial and maintenance cost. They are the most widely used helicopters in the world.

New Plane Equipment Previewed For Engineers During Meeting

New York—New developments in equipment, accessories and manufacturing processes were a technical highlight of the National Aeronautic Meeting of the Society of Automotive Engineers here last week.

Among the exhibits:

• **Hoover Electric Co.** displayed its large line of electro-mechanical actuators used on many military jet aircraft, including the F-100, F-102B, F-107 and the Navy FJ-4. The latter plane uses nine Hoover actuators in such applications as rudder trim tab, cockpit canopy, flight control, wing landing flap and stabilizer bungee trim.

The 4,040 lb.-load wing flap actuator can mechanically actuate both sets of wing flaps, a boundary-layer control system and droop both ailerons. It also actuates the leading edge slats through a built-in relay.

The actuator incorporates micrometer adjustments so that position of both wing flaps may be synchronized exactly.

A load sensing device stops flaps from extending if the pilot inadvertently tries to lower them above placarded speed.

Flex shafting assures complete movement synchronization between both flaps and allows one actuator to lower both flaps in case one of the pair of actuators fails.

All Hoover actuators feature module-type construction which makes it possible for standard boxes—relays, controls, motors and the like—to be assembled in a manner best suited to a particular installation.

• **Sperry Gyroscope Co.** displayed a new fire detection system and a turbine engine vibration indicator.

Sperry's Aeronautical Equipment Division has designed and manufactured a new airborne fire-detection system containing a continuous, coaxial sensing element, amplifier and alarm circuits. Magnetic amplifiers and rugged, non-sensitive relays make for dependability, according to Sperry.

The heart of the system is a light-weight, semi-flexible sensing element which uses a Sperry-developed, heat-sensitive ceramic. The ceramic's capacitance changes radically when heated and provides the alarm signal. The system responds quickly to overheat or fire and resets itself automatically when safe conditions are re-established.

The sensing element will withstand up to 2,000F without damage. It can be supplied in lengths varying from 15 to over 100 ft.

The system alarms accurately to a specified, pre-set temperature, regardless of line voltage or frequency variations. It meets SAE Aeronautical Standard Specifications AS401A.

Sperry says the turbine vibration detection equipment "makes routine measurement and analysis of turbine jet engine vibration practical in airborne, flight line and test cell applications."

The vibration indicator, which can be portable for airborne use, compares an engine's vibration to the limits set by its manufacturer. The equipment warns of excessive vibration and permits localizing and diagnosis of specific vibration causing engine malfunctions. It is now in prototype form.

The vibration pickup is designed to withstand severe temperature and other extreme conditions found in jet-engine operation. It has completed a 1,000-hr. jet engine endurance test without serious failure or change of electrical output, according to Sperry. Methods of presentation and packaging have not been finalized.

• **W. H. Nichols Co.** displayed a very simple, internal gear-type pump called the Gerotor. The pump consists of only two parts, the inner and outer Gerotor. With the pump operation at 2,000 rmp., the relative speed between the two elements is 200 rpm. in a typical application.

Advantages of the pump include good high-altitude performance because the slow relative movement between the two parts eliminates sudden shock, rapid pressure changes and turbulence which engender oil foaming, particularly at high altitude. The slow speed also keeps wear to a minimum and assures quiet operation.

The pump's elements can be stacked on a single shaft to perform several jobs such as lubrication, scavanging, and boost.

The Gerotor pump is valveless and provides good mechanical and volumetric efficiency. It may be used with many mediums, including oil, fuel, freon or water.

The positive displacement pumps currently are installed on such engines as the J40, J34, J71, and J47. It also is used by many helicopter manufacturers for oil pumps in helicopter transmissions.

• **Linde Air Products Co.** displayed a new metal coating process called Flame Plating. The process sprays powdered tungsten carbide or aluminum oxide on a variety of metals including steel, cast iron, aluminum, copper, molybdenum, titanium, nickel and magnesium.

The process blasts the metal powder from the barrel of a specially-designed

how to make a "Tiger" roar!

TELEFLEX® cable control assures positive throttle action on new Grumman F11F-1

Flashing into supersonic speeds, the pilot of the Navy's new Grumman Tiger jet gets instantaneous response when he gives it the gun. The throttle control that pours on the fuel is provided by a 20-foot Teleflex control linkage.

In designing the F11F-1, Grumman fighter built to pioneer in using the new "area rule," Grumman engineers wanted a throttle control system that would—

1. Meet handle load specifications
2. Be light and trouble-free
3. Be sensitive, accurate, reliable
4. Operate under the temperature extremes encountered in supersonic flight
5. Meet pressurization requirements

Easily installed Teleflex meets all these requirements . . . and more. The cable-in-conduit, mechanical remote control system follows a devious path through the F11F-1's fuselage to give throttle action that is accurate, positive. *Another* control problem solved with Teleflex!

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Teleflex is a compact, single-path control linkage that follows any desired devious route. A flexible, rack-like cable, operating through precisely drawn conduit, transfers linear, arc, or rotary controlling motion as tension or compression push-pull motion. Wherever rotary motion (up to a full revolution or more) is required, the cable helix meshes with and turns a hobbed control wheel.

DESIGN ENGINEERS: For detailed engineering data, write to TELEFLEX INCORPORATED, 125 S. Main Street, North Wales 9, Pa., for your copy of Catalog 400.

TELEFLEX
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Cessna T-37 designed for Jet Training

To meet jet age demands, the U. S. Air Force requires a jet trainer that makes it easy for cadet-pilots to master first-line combat airplanes.

The Cessna-developed T-37 introduces the cadet to all combat jet airplane characteristics while training on this safe, easy-to-fly jet trainer.

It is designed to provide the Air Force with a jet trainer that can be operated at substantial savings and cover the most important and longest phase of the cadet-pilot's jet training.

It is a privilege for us here at Cessna to team with the Air Force in its forward-thinking plans for the jet age. CESSNA AIRCRAFT COMPANY, Wichita, Kans.

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gun at ten times the speed of sound. Temperature inside the gun is raised by oxygen and acetylene to 6,000F, yet the metal being treated is heated to only 400F. Coating thickness can be from .002 in. to .10 in.

Both tungsten carbide and aluminum oxide are used to prevent wear, fretting corrosion and erosion. The former metal is good to 1,000F; the latter, a new application, has been tested successfully to 1,400F.

• **Electrofilm, Inc.,** showed two products:

The first is a sprayed-on, electrical heating element. Application consists of spraying on a .005 in. thick base insulating coat, a .005 in. coat of Electrofilm heating element and a protective coating .001 to .005 in. thick.

Features include ease of application, lightness—it weighs .07 lb./sq./ft. including electrodes—and thinness (from .011 to .15 in.).

The second is a solid film lubricant which is effective against galling, seizing and fretting corrosion. It stands up well under very high loads and speeds. The product also allows constant torque actuation at temperatures down to −100F.

Certificates of Necessity

Washington — Lockheed Aircraft Corp. has been awarded 10 certificates of necessity totaling $4,811,516 for rapid tax amortization by the Office of Defense Mobilization. Eight are for facilities for military aircraft and two for research and development facilities. Seven had 65% allowed and three had 60% allowed for accelerated amortization.

Other certificates for the period Mar. 8-21:

Douglas Aircraft Co. Inc., Santa Monica, Calif., military aircraft, $500,000 certified with 60% allowed; military aircraft, $343,429 certified with 65% allowed; El Segundo, Calif., military aircraft, $98,825 certified with 65% allowed.

American Instrument Co., Silver Spring, Md., precision scientific instruments, $23,733 certified with 70% allowed.

Cooper Alloy Corp., Clark, N. J., airplane engine parts, $970,000 certified with 40% allowed.

Motorola, Inc., Riverside, Calif., research and development, $47,351 certified with 65% allowed.

Titanium Metals Corp. of America, Henderson, Nev., titanium melting facilities, $658,520 certified with 90% allowed.

Robertshaw-Fulton Controls Co., Anaheim, Calif., research and development, $68,739 certified with 65% allowed.

AVCO Manufacturing Corp., Crosley Division, Evendale, Ohio, military electronic components, $206,888 certified with 65% allowed.

Kearfott Co., Inc., Black Mountain, N. C., military aircraft instruments, $32,390 certified with 65% allowed.

Certificates for the period Feb. 23-Mar. 7:

General Precision Laboratory, Inc., Pleasantville, N. Y., research and development,

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In keeping with its plan of rotation, the U. S. Department of Defense has designated Oklahoma City the site of this year's aviation classic—the National Aircraft Show.

Here, for the first time in the southwest, the aviation industry in cooperation with the Armed Services will dramatically report to the nation the progress of our air power.

It is the only major show for 1956 approved by the U. S. Department of Defense and sanctioned by the National Aeronautic Association. It will carry full participation by all branches of the Armed Services, both in flying demonstrations and static exhibits of aircraft and equipment.

Spacious hangars for indoor displays and vast outdoor exhibit areas offer airframe, engine and component parts manufacturers a singular opportunity to effectively present their latest developments to all the Services, the industry and public . . . for this is aviation's traditional annual rendezvous. It merits your serious consideration and active participation.

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$46,000 certified with 65% allowed.

Titanium Metals Corp. of America, Henderson, Nev., titanium melting facilities, $129,410 certified with 90% allowed.

Hartford Tool & Die Co. Inc., Bloomfield, Conn., aircraft engine parts, $63,105 certified with 70% allowed.

Welco Inc., Wellington, Kan., military aircraft parts, $35,545 certified with 70% allowed.

Ryan Aeronautical Co., San Diego, Calif., military aircraft parts, $34,829 certified with 65% allowed.

Fenwal Inc., Ashland, Mass., scientific instruments, $12,256 certified with 70% allowed.

Douglas Aircraft Co. Inc., Santa Monica, Calif., military aircraft, $489,812 certified with 65% allowed; military aircraft, $817,844 certified with 65% allowed.

Vertol Stockholders Vote Ouster of Frank Piasecki

Barring legal intervention, three directors of Vertol Aircraft Corp., Morton, Pa., will be replaced at the company's annual meeting on May 10. Vertol formerly was Piasecki Helicopter Corp.

Slated for ouster from the board are Frank N. Piasecki, founder and former chairman; Donald N. Myers and James J. Davis Jr. All are officials of Piasecki Aircraft Corp., a new company formed after Piasecki's removal as board chairman of the helicopter firm.

The replacements were authorized by Vertol's stockholders with adoption of an amendment to their by-laws requiring that board members "cannot be in a position of conflicting interests." Vertol's president, Don R. Berlin, has maintained that Piasecki Aircraft competes with the original company and that the presence of its officers on Vertol's board restricts freedom of discussion on new projects.

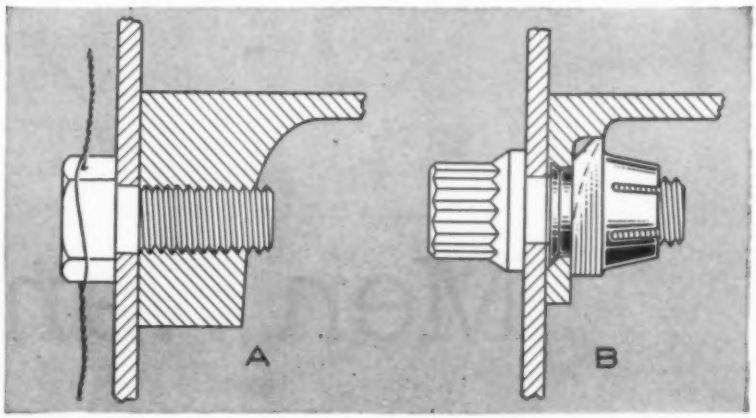
President to Review Any Nonsked Foreign Flights

Washington—Supplemental air carriers have been approved for overseas and territorial service by the White House, but the President has delayed his decision on their use in foreign transportation because foreign policy considerations are involved.

The Civil Aeronautics Board stayed the effective date of the foreign and overseas provisions of its interim decision in the Large Irregular case when the domestic provisions became effective, and submitted the foreign and overseas provisions to the White House for comment.

President Eisenhower has told the CAB to go ahead with authority for supplemental carriers to operate to and within U.S. territories and possessions. But he asked the Board to stay its interim decision in relation to foreign transportation until a final decision is reached in the Large Irregular Case. The President wants the final decision submitted to him for approval.

FASTENER PROBLEM



Self-positioning blind fastener for jet engine flange assemblies

There have been two commonly used methods for fastening flange-type assemblies on jet engines—for such applications as attaching compressor to rotor sections; stator diaphragms to case sections; and securing air seals. The most common design practice has been to use a flange structure thick enough to provide tapped bolt holes with sufficient metal thread length to carry the design load. (Illustration "A") Method number two was to use a thinner flange section supplemented by reinforcing metal "tapping" strip with threaded bolt holes. In both cases the flange assembly carried a heavy weight penalty, and extra labor and material costs were involved in the installation of the locking devices or extra assemblies.

Solution: Such applications have become even more critical with the development of engine designs which eliminate the main rotor shaft by consecutively fastening each compressor stage to its neighbor. The need for a dependable time-and-weight-saving "blind" fastener is met by *ESNA's Type ZL2440* self-wrenching locknut. The shank on this Elastic Stop® nut is permanently flared into place on the bolting flange. The part is prevented from turning by an eccentric lug on the nut which bears against a shoulder on the flange. (Illustration "B")

Type ZL2440 is manufactured from A286 alloy stainless steel to guarantee exceptional tensile performance at elevated temperatures. The ESNA longbeam locking device assures dependable, tested, self-locking performance at elevated temperatures. This new fastening method provides *major weight savings* through flange redesign: it also results in assembly time savings and lower costs.

MAIL OUR COUPON for design information on the ZL2440 nut and other ESNA self-locking fasteners.

ESNA

Dept. N6-425, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

☐ Standard Drawing of Type ZL2440

☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

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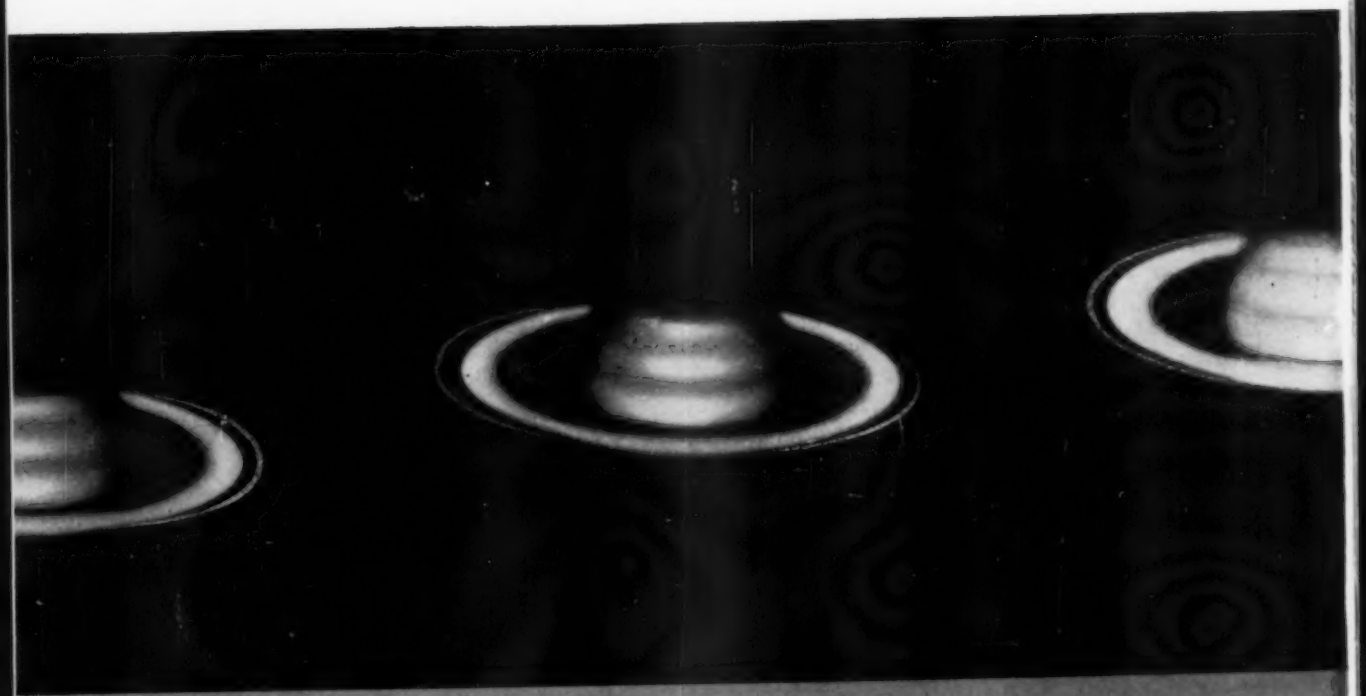
Men Wanted



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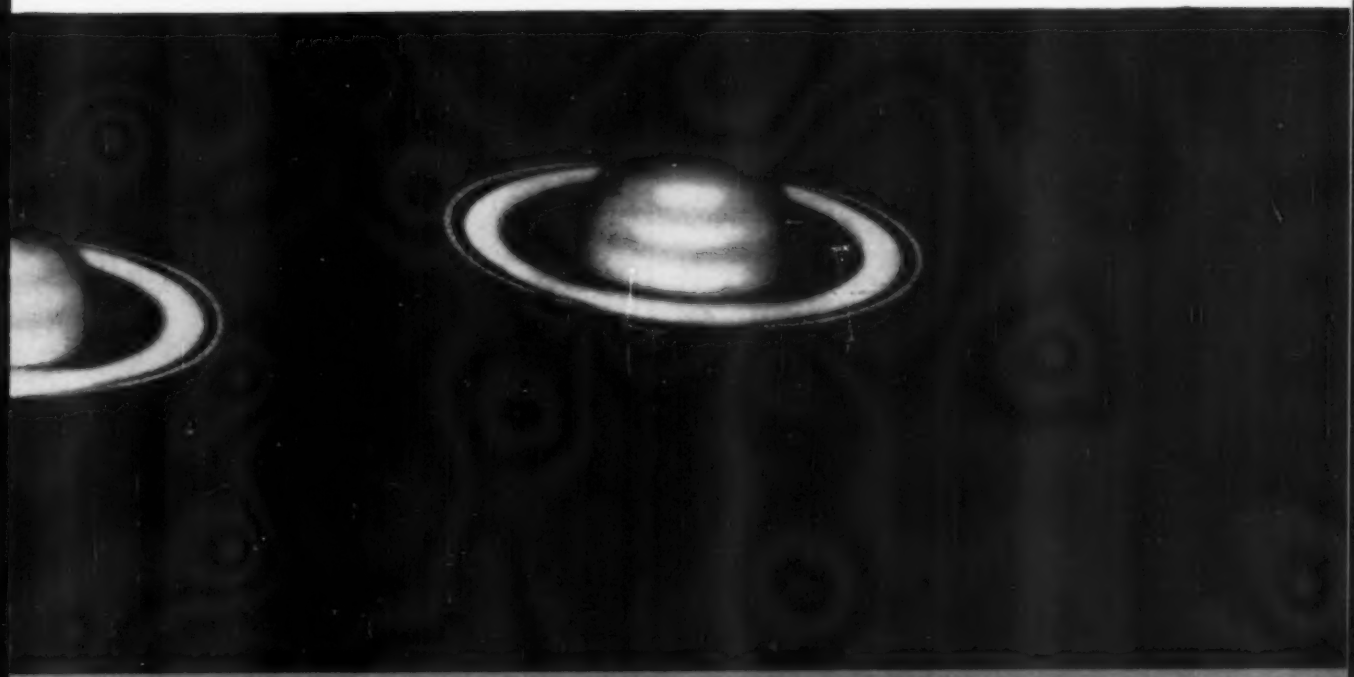

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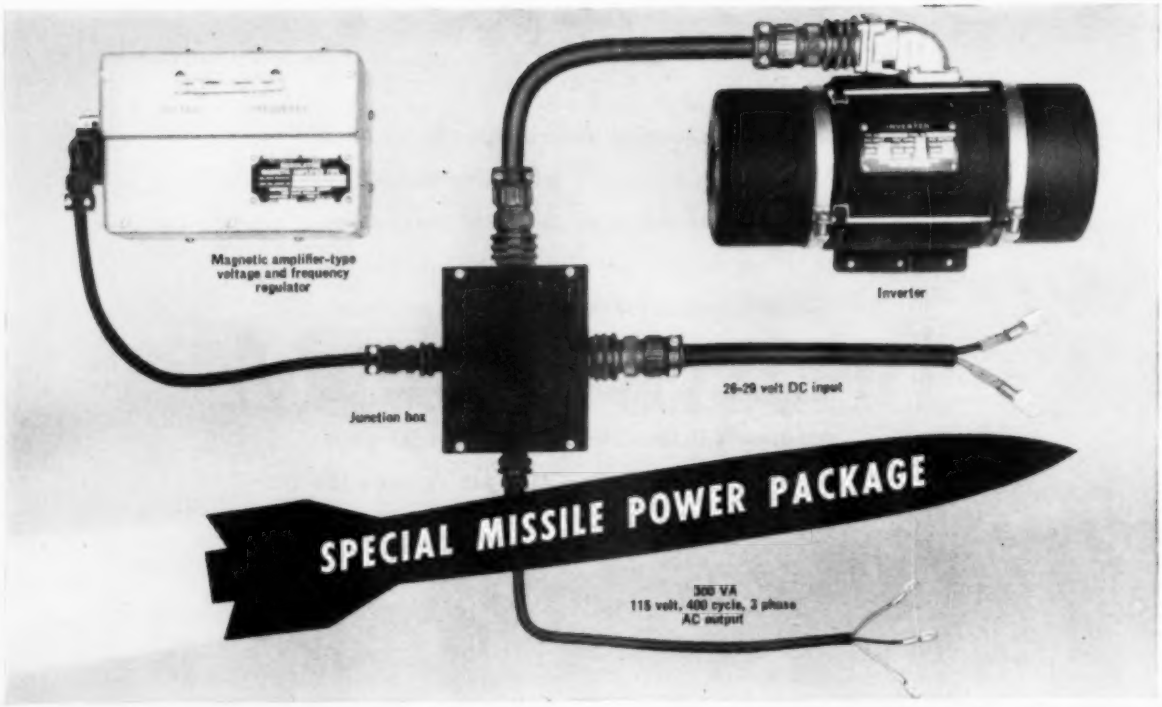

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INVERTERS — 400-CYCLE OUTPUT

Type	Input Volts	Input Amps.	Rated Output Volts	Rated Output Phase	Rated Output VA Rating	Max. Altitude at Rated Output	Approx. Wt. Lbs.	Designed to Gov't. Part No.
12128	27.5	1	26	1	6	35,000	2.2	AN3496
12126	27.5	2	26	3	10	35,000	2.3	E1615
32B21	27.5	3	115	1	20	50,000	5	—
MG-93	27.5	12	115/200	1 3	100 100	65,000	10	E5134
MG-54	27.5	22	115/200	1 3	250 250	50,000	17	E5109
12142	27.5	22	115	1 3	250 250	35,000	13	E1617
12143-1	27.5	22	115	3	250	35,000	13	—
12143-2	27.5	22	115	1	250	35,000	13	—
*32B15	27.5	22	115	3	300	50,000	14	—
32E01	27.5	35	115	3	500	50,000	26	AN-3533-1
32E00	27.5	51	115	1 3	500 750	50,000	34	AN-3534-1
MG-65	27.5	52	115/200	1 3	750 750	50,000	35	E52805-2
MG-61	27.5	126	115	1	1750	50,000	54	53C6767
1518	27.5	126	115	1 3	1500 1800	20,000	37	—
32E06	27.5	160	115/200	1 3	2000 2250	50,000	56	E1725
32E03-3	27.5	150	115	1	2500	50,000	58	53B6227
*32E03-8	27.5	160	115	1	2500	50,000	65	53B6227
*MG-77	27.5	150	115/200	3	2500	50,000	65	—
*32B49	27.5	160	115/200	1 3	2500 2500	50,000	65	E54807
MG-81	27.5	160	115/200	1 3	2500 3000	50,000	61	E1725
MG-95	27.5	160	115/200	1 3	2500 3000	50,000	58	E54807
32E09	27.5	160	115	1 3	2500 3000	50,000	60	—
32B27	27.5	285	115/200	1 3	3500 4000	50,000	76	—

*These inverters have magnetic amplifier "static" type voltage and frequency regulators.
NOTE: D.C. Input Voltage shown is nominal value of 27.5 volts, but all units are designed for 26 to 29 volt operation. Input amperes shown are rated at 27.5 volts input.

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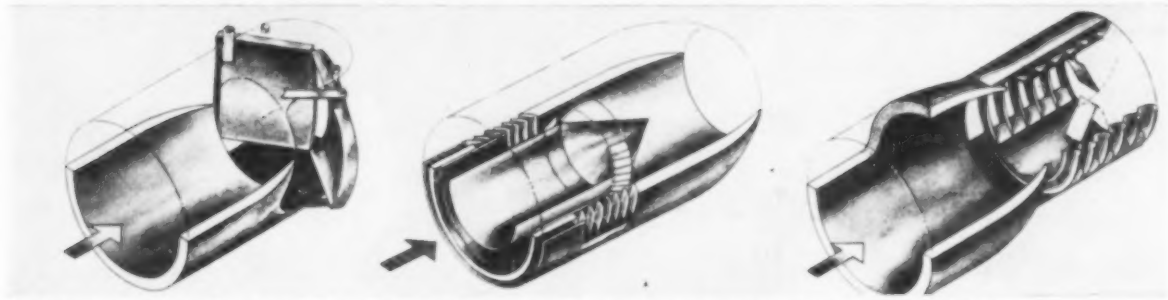
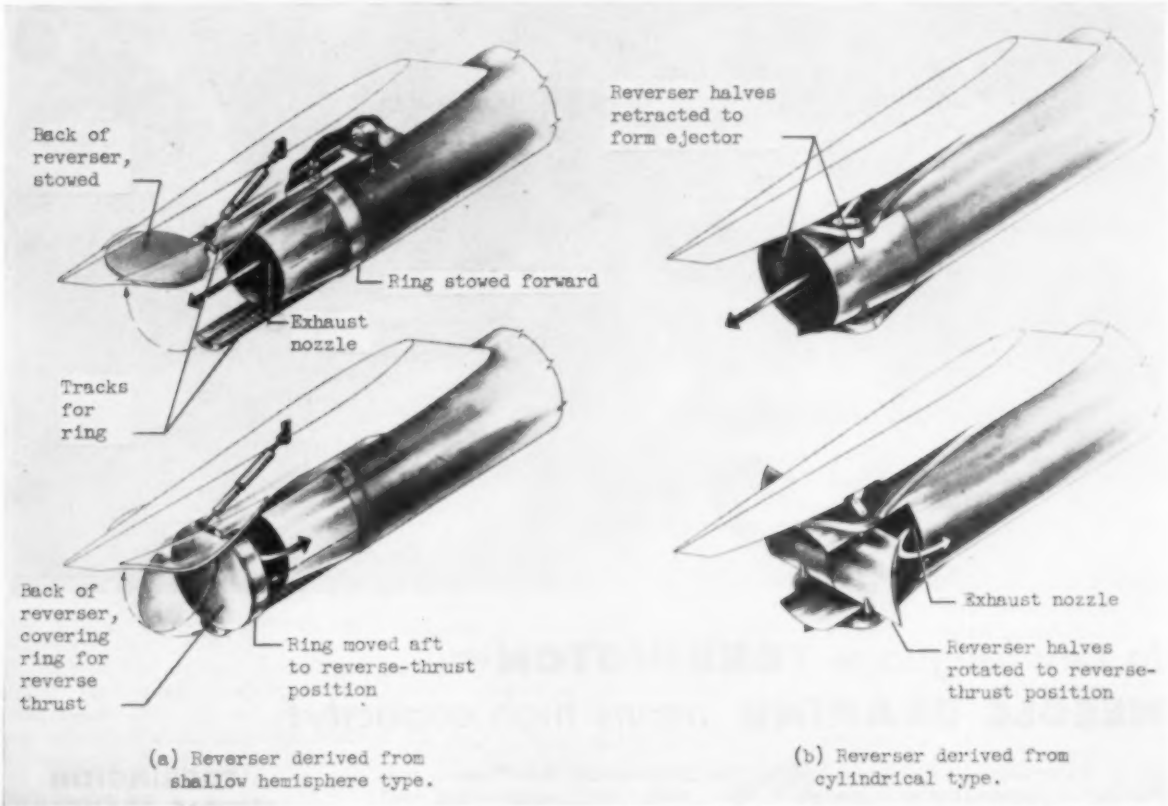


TARGET, internal-cascade and external-cascade are the three ways of reversing a jet engine's thrust studied by NACA.


Back of reverser, stowed
Ring stowed forward
Exhaust nozzle
Tracks for ring
Back of reverser, covering ring for reverse thrust
Ring moved aft to reverse-thrust position
(a) Reverser derived from shallow hemisphere type.
Reverser halves retracted to form ejector
Exhaust nozzle
Reverser halves rotated to reverse-thrust position
(b) Reverser derived from cylindrical type.

FOR IMMEDIATE USE, target-type reverser offers good performance and fewest objections. These are on pod-mounted jet engines.

How to Choose a Jet Thrust Reverser

By Robert Cushman

A yardstick to aid designers in selecting jet-engine thrust reversers has been devised by the National Advisory Committee for Aeronautics' Lewis Laboratory in Cleveland. The yardstick, incorporated in an NACA summary*, includes these details:

- **Target reversers** offer good performance and the fewest objections to immediate use.
- **Internal tail-pipe** cascade reversers promise the most for refinements.
- **External cascades** are touchy in design and somewhat inferior to the other two types in reversing performance. But they are adequate for present reversing requirements and offer the possibilities of light weight and minimum actuation forces.

NACA considers all three types in the running. Their studies of this form of high-speed jet aircraft brake parallel those currently being made by Marquardt, Aerojet-General, Goodyear, Boeing, General Electric, Douglas, Snecma and Rolls-Royce.

Research Pattern

The pattern of NACA research has been to first select workable types of reversers and then to see to what extent

* Summary of Scale-Model Thrust-Reverser Investigation" (NACA TN 3664)—by J. H. Povolny, F. W. Steffen and J. G. McArdle, Lewis Laboratory, 1956.

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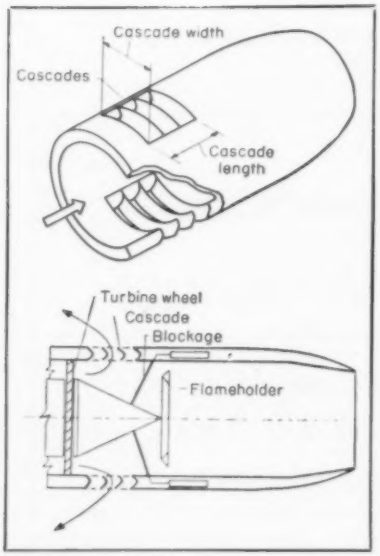

CASCADE-TYPE jet reverser.

the basic type can be simplified and refined to harmonize with anticipated aircraft.

Adequate Thrust No Problem

Taking 40% as the minimum ratio of rearward-to-forward thrust needed to stop future jet aircraft within the confines of existing airports (AW April 19, 1954, p. 29), NACA found that all three types investigated could achieve this limit with ease. In fact, the tailpipe cascade could go up as high as 73% reverse-thrust ratio without having the reversed flow attach itself to the cowling.

Flow attachment to the cowling was used as an upper limiting factor because, with it, there is a tendency for the reversed exhaust gases to work their way forward and become sucked in again by the engine's compressor. At aircraft speeds under 50 mph., enough gases would enter to raise the inlet temperature by 200 F.

Limiting Factor

Another limiting factor was brought about by the probable need to alter the shape of the reversed gas stream to avoid hitting parts of the aircraft.

NACA approximated this by dividing the exhaust gases into two separated lobes which could be shot out on each side to miss the engine-pod pylon and also pass below the wing and above the runway.

This distortion of simple reversed flow further reduced the amount of reverse obtainable. It was particularly hard on the performance of the external-cascade type.

Thus, while all three types meet the minimum specifications, the internal cascade has the greatest reserve. Theo-

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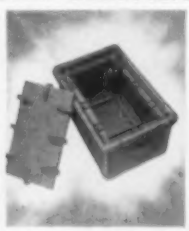

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retically, at least, since it has inherently more reversing ability, it is capable of withstanding more modifications and ending up as the most compact and lightest of the three types under investigation.

Neglected Type

The NACA research presents some of the first published results of internal tail-pipe cascade testing. Goodyear Aircraft claims it is leading in practical development of this type.

Besides high reverse thrust, the internal-cascade type has a number of significant virtues. It is less sensitive to design and manufacturing variations and can be controlled in a linear fashion. Of the three types of reversers, the internal cascade appears most compatable with the exhaust silencers recently announced by both Rolls Royce and Boeing.

Disadvantage

But against its virtues must be stacked the facts that its mechanism has to operate inside the high temperatures and pressures of the tail-pipe and that installing this type of reverser will necessitate cutting into the basic engine.

NACA results placed the target type reverser in between the internal and external cascade types on most counts. Performancewise they are just below the external cascades and quite a bit above the external cascades.

NACA reported that the external ring cascade was difficult to proportion; it showed marked sensitivity to vane and deflector design. The French firm Snecma, however, claims it has had considerable success with variations of this type of reverser (AW June 8, 1953, p. 40).

Control of Reverse Thrust

Each of these types can be made to control the amount it reverses the engine thrust from full forward through intermediate idling ranges of no thrust to full reverse, NACA found.

The report does not attempt to suggest flight techniques using reversers nor does it elaborate on the dangers of sideways unbalance of the reversed thrust, compatability of thrust reversers with noise silencers, possibility of combination of direct lifting thrust with reversing capability or any of the many other dangers and possibilities ahead before the large jet transport landing problem has been solved. But the report does give a clear, basic picture of the abilities of these three prominent types of reverses.

The data is based on four inch nozzle diameter model tests using non-heated air plus a limited amount of full scale verification.

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

Remember the old style hood ventilator, the type that opened when you shoved the handle forward under the dash and closed when you pulled it back?

You can find much the same vent on such jet aircraft as North American's F-86D and Lockheed's F-104A — refined, of course, and Whittaker-made — but now it's known as a ram air scoop.

The Southern California valve company has built hundreds of the efficient little scoops which some engineers feel should be installed as standard equipment in every pressurized cockpit as a basic safety precaution.

The contoured unit fits flush on the side of the fuselage in the cockpit area and operates with the flick of a small lever to open into the slipstream at any one of six settings.

Its function: A safety device to clear the cockpit air of armament smoke, fumes, oil mist, etc., when for any reason the normal pressure and air conditioning system cannot handle the job.

Whittaker took up ram air scoop design when some of the majors realized the necessity for a secondary cockpit air system that would function without fail in an emergency.

Jet pilots now and then were confronted with serious situations wherein the standard pressure system wouldn't take care of cockpit smoke, for instance, and they found themselves struggling to see through an acrid haze that at the same time burned and irritated their eyes.

Whittaker took on the job of designing a simple scoop that could be used at any speed and which would admit as much air as necessary.

Basically simple in action, the scoop proved to be somewhat tricky in design, considering the actions, the loads and the mechanisms required, the castings necessary and the problem of making the unit sufficiently light — through use of plastics — yet sufficiently strong.

As currently produced, the scoop is mounted integrally on a plate that is curved to fit the contour of the fuselage. The door, itself, lies flush until opened with a small lever at the pilot's hand. It is about three inches high and two inches wide, opening into the slipstream anywhere from an eighth of an inch to three-quarters of an inch. Interior of the scoop is approximately three-quarters inch by an inch and a half.

The pilot simply presses a detent button on the top of the small lever and moves it to the position desired where it is locked open. Movement of the lever trips integral microswitches that shut off the cabin pressurization and air conditioning system, actuate the cabin pressure dump valve, turn on the radar blower, etc.

In the open position, air rams into the scoop, rushes through one or two rubber-sealed check valves, builds up ram pressure within the cockpit and sweeps smoke or fumes out of the cockpit dump valve. A flick of the finger—without using the detent button—closes and locks the scoop in an instant, at the same time re-actuating primary cabin pressure and air conditioning.

Normally the plate containing the scoop unit is about seven inches by five inches, although Whittaker can build both plate and scoop to any desired size. Larger units are being considered as secondary systems for forthcoming transport flight stations to eliminate the necessity for "cracking" a section of cockpit windows for emergency ventilation.

There's also a possibility the ram air scoop may be tied in with a fighter pilot's pressure suit for use in emergencies.

So efficient are the little scoops that jet pilots on low altitude flights sometimes don't actuate the regular air conditioning system. They simply open the Whittaker unit to provide cockpit ventilation!

And it takes only a split second, for at jet speeds the little gapemouth inhales a great rush of air that flows into the cockpit like a hurricane.

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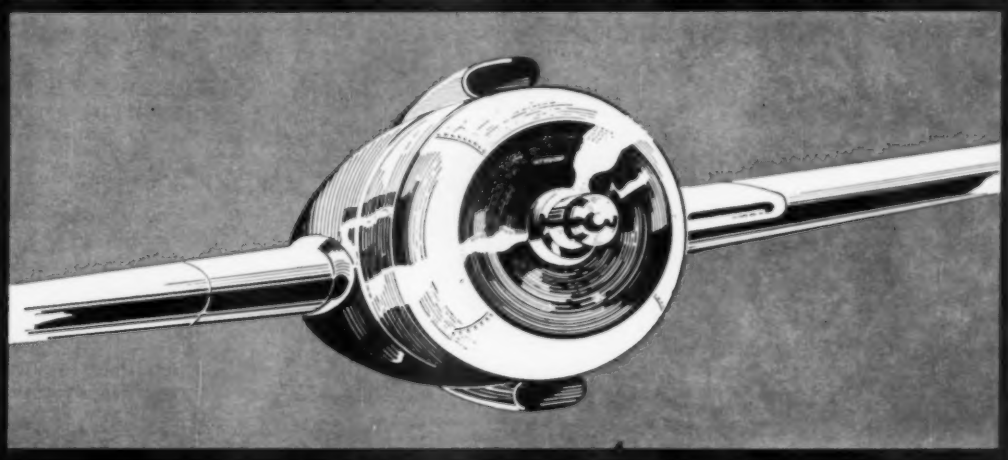

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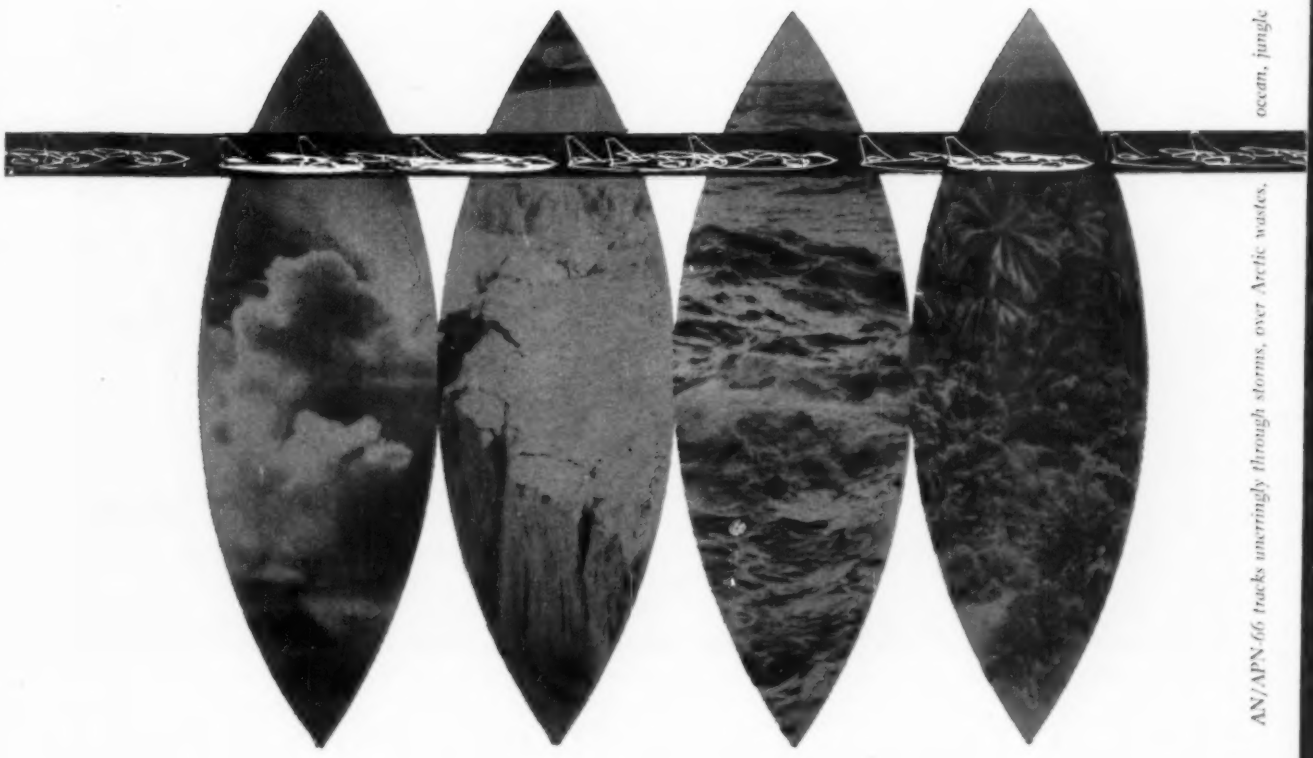

AN/APN-66 tracks unerringly through storms, over Arctic wastes, ocean, jungle

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GPL — in conjunction with Air Force Weapons Guidance Laboratory — has produced the most advanced automatic air navigation system in operational use — AN/APN-66.

This GPL system guides an airplane to its destination under any conceivable conditions. It is completely self-contained; needs no ground guidance, no search radar, no optical observation. It works equally well anywhere in the world. Virtually instantaneously, and with unprecedented accuracy and speed, AN/APN-66 will always tell exactly where a plane is and where it must go to reach its goal.

The military application of a system of such capabilities is far reaching. To achieve these capabilities, GPL mobilized scientific manpower and facilities on a large scale. Four other GPE companies took part. Even so, development of AN/APN-66 took 8 years, for it required a seemingly impossible engineering achievement: the harnessing of the "Doppler effect."

The Doppler effect is the shift in the frequency of waves, sound or electrical, transmitted from a moving object to a stationary one. It is most familiar as the shift in the pitch of a train whistle as it approaches and passes. AN/APN-66 measures a similar shift in the frequency of electro-magnetic waves it bounces off the earth's surface below. From the difference in frequency between the original wave and its echo, the system computes the plane's speed and direction, then uses this data to keep continual track of the plane's position.

AN/APN-66 and its variations, AN/APN-81, 82 and 89, have flown millions of operational miles in transports, hurricane hunters, patrol craft, bombers. They are steadily going into more types of aircraft as standard equipment. When put to civilian use, they will guide air liners to the remote corners of the world.

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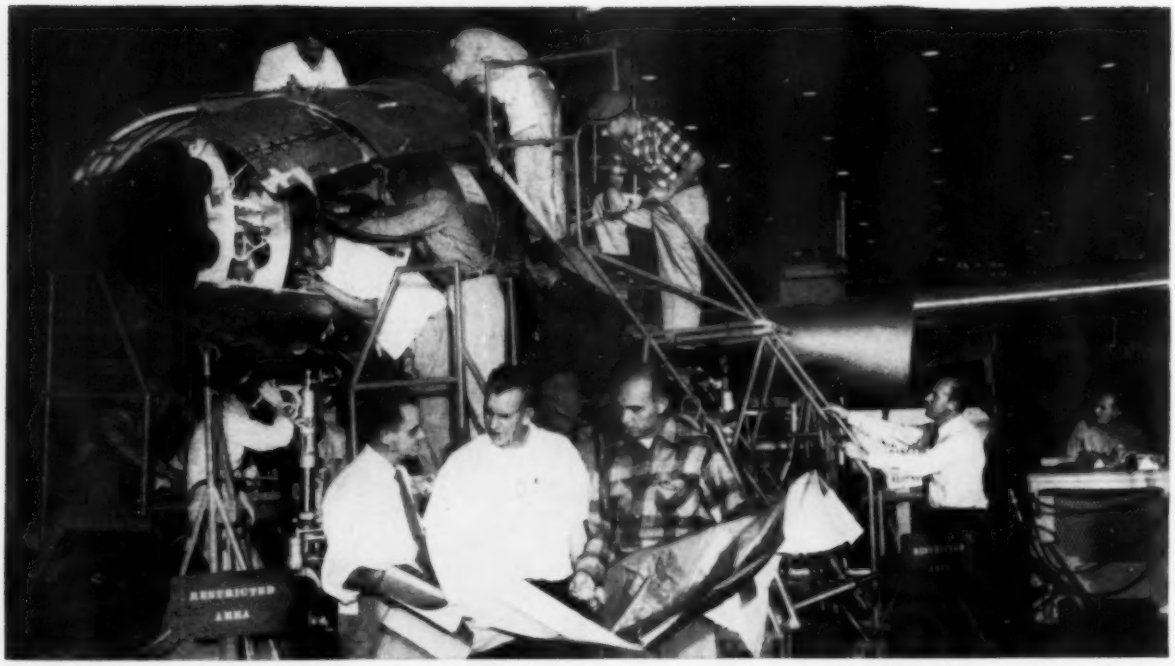


FINAL TOUCHES are put on first T2V-1 jet trainer built for Navy at Lockheed's California Division. It can be operated from carriers.

T2V-1 Design Gives Better Performance

By Richard Sweeney

Burbank—The Lockheed T2V-1 trainer, developed for Navy carrier operation, provides better all around performance and low speed characteristics than the T-33.

An evolution of the T-33 design, the Seastar has:

- **Boundary layer control** for greater lift at low speeds.
- **Leading edge slats** for increased lift and stability at low speeds. (Pilots say S-turns can be made during a stall.)
- **A redesigned empennage** for greater stability over the entire speed range.

With the improvements, landing speed is reduced 4 kts., takeoff speed is cut 7 kts. and pattern speeds are down 15%. Takeoff roll is shorter and rates of climb better at all weights.

The centrifugal flow Allison J33-A24 turboject rated at 6,100 lb. dry static thrust is used with air impingement starting. Also usable without airframe modification are the J33-A16, A22 and Pratt & Whitney J48 engines. The A24 engine provides sufficient thrust to drive the aircraft's increased gross weight (up more than 1,000 lb.) to the critical .8 Mach of the airfoil, which is unchanged from T-33 in section and planform.

The pilot controls BLC, on or off with the A24 engine, 3% bleed air is allowable without disturbing the fuel-air ratio. Air is collected by a circular manifold from engine compressor chambers and piped through a 3-in. aluminum tube to an .030 in. slot along the rear of the wing.

It is discharged through this slot as boundary layer flow over the top of the flap leading edge for the full flap span. The rate if 1,290 cu. ft. per min. at maximum engine rpm. As engine rpm. is reduced, airflow metering reduces BLC bleed proportionately, since overall compressor output is reduced.

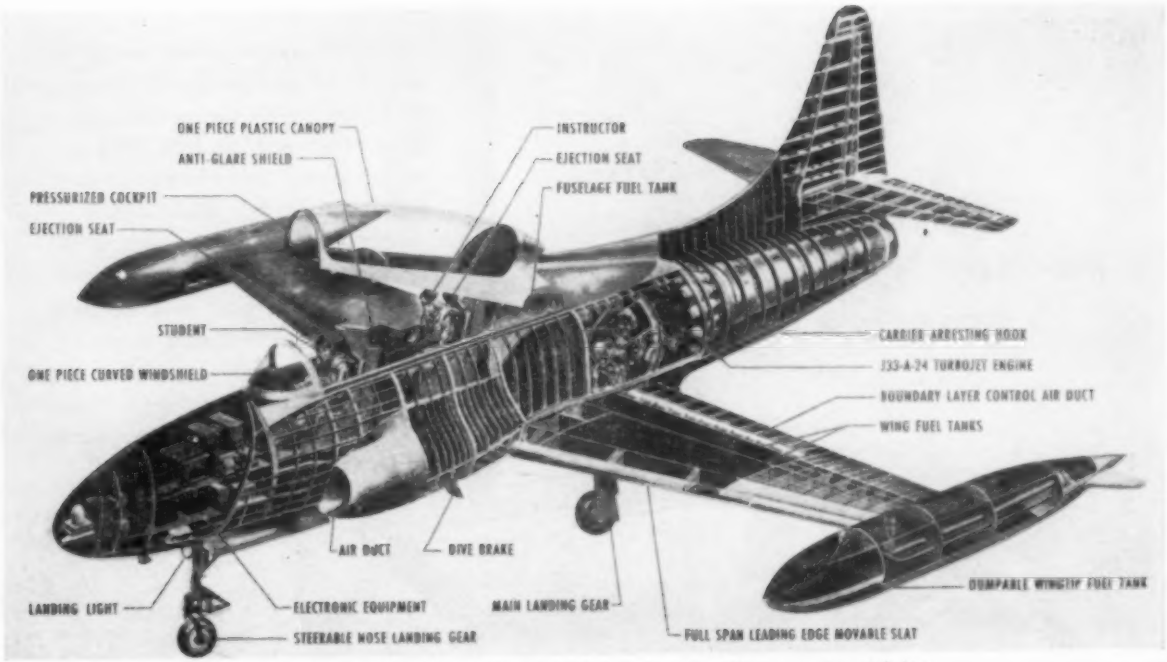
The slats operate aerodynamically, extending when the proper airspeed and angle of attack are reached.

SEASTAR on Burbank runway. Leading edge slats and tail revisions are shown.

Empennage Changes

Redesigned empennage features a vertical stabilizer and dorsal fin increased 30.1 sq. ft. in area over the T-33 for a new total of 47.3 sq. ft. The vertical stabilizer was increased 20 in. in height. Rudder area was increased 2.5 sq. ft.

Horizontal stabilizer was relocated 20 in. higher on the fin than on the T-33. Span and chord changes give it a new aspect ratio. Span is increased 12 in. and area is increased 11.3 sq. ft.



TRAINER CUTAWAY reveals position of instructor pilot, raised higher than in T-33 for greater visibility.

Than T-33

Elevator area is increased 1.03 sq. ft.

Standard weight is 15,500 lb.; maximum takeoff gross, 16,800 lb. and landing weight, 12,000 lb. Wing loading varies from 45 to 65 lb. per sq. ft.; wing span is 42 ft. 9.94 in. including the integral 230 gal. tip tanks; length is 38 ft. 6.6 in. and height, 13 ft. 3.9 in.

Climb Rate

At sea level, rate of climb is 6,330 fpm. at combat weight and 5,400 fpm. at takeoff weight. Maximum airspeed is 504 kts. at 35,000 ft.; rate of climb is 2,850 fpm. at combat weight and 2,150 fpm. at takeoff weight. Maximum airspeed is 465 kts. Service ceiling is 40,000 ft.

Fuel system provides for single point high pressure refueling reducing refueling time to one third that of the T-33. For low pressure refueling, two tip tank and one fuselage tank refueling points are provided.

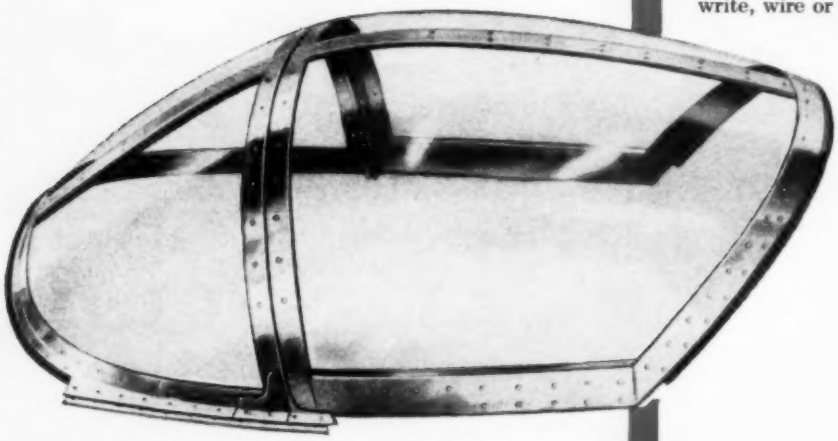
To prevent unequal flow from tip tanks, which are pressurized and gravity feed into the main wing tanks, symmetrical tank plumbing and pilot-operated shutoff valves at each tank are incorporated.

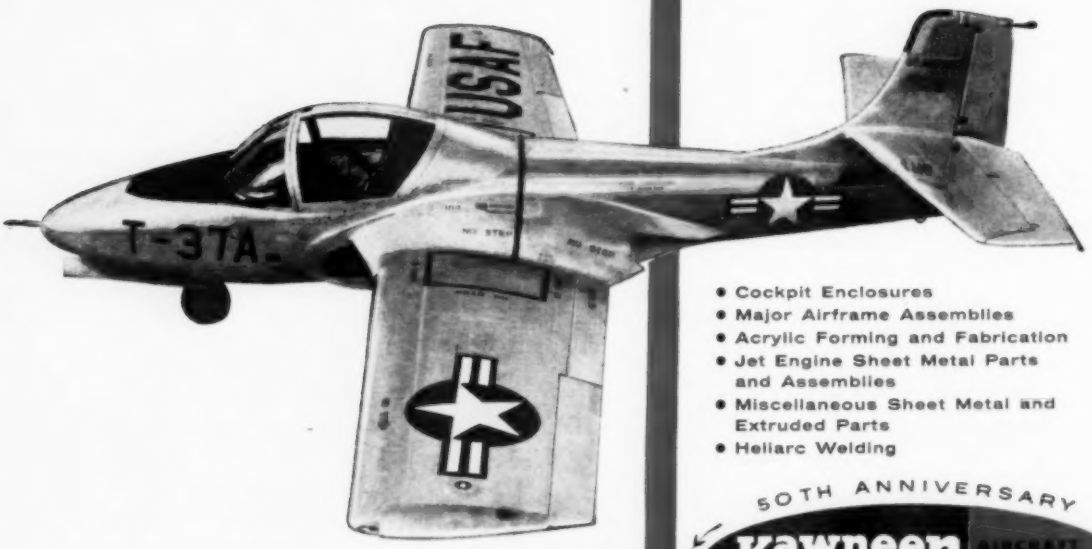
Auxiliary wing tanks and the fuselage tank also gravity feed into the main wing tanks, at the lowest point in each of which is located an electrically driven boost pump. Either pump can sustain 100% engine power, and a crossfeed is

PLANFORM of Lockheed's T2V-1 duplicates that of its T-33 predecessor.

Contributing precision-made cockpit enclosures to America's air arm

The Cessna T-37 will help to train tomorrow's jet pilots faster and at less cost. An enlarged cockpit enclosure made by Kawneer gives the instructor and trainee improved visibility. With our knowledge of acrylics and specialized facilities in our new, modern plant we are prepared to take the complete responsibility for your cockpit enclosure program. Our forming, routing, edging, optical testing and glazing to metal facilities are available to produce any part of your cockpit enclosure—from the acrylics only to the complete assembly—write, wire or phone.





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Crosswind Rato Assist

Grumman SA-16A gets a directional assist from a tail mounted Rato unit during crosswind takeoff tests from ice and snow at Lake Bemidji, Minn. Rato mount, installed by Grumman for the Air Rescue Service tests, pivots with the rudder to provide control. Both ARS and Grumman say the tests were very successful. The Albatross was able to takeoff in crosswinds otherwise impossible to negotiate. Similar use in water takeoffs are being made at Eglin AFB.

provided in case one pump fails. Should both boost pumps fail, the engine driven pump can deliver enough fuel to sustain level flight at altitudes up to 10,000 ft.

Fuel remaining and capacitance type gauges are provided.

Electrical System

The electrical system incorporates a 400 amp. d.c. generator and two buss systems with priority provided. Normally, both busses are in, but the secondary buss cuts out at any indications of a major electrical failure. The primary buss then draws sufficient battery current to maintain safe flight.

Two 24v. 36 amp. batteries are used, plus one 250 v. inverter and one 1,500 v. inverter.

Cockpit temperature is thermostatically controlled. Cockpit lights are individual red rim type. Electric dive flap and elevator trim tab position indicators are used.

Communications

The plane incorporates a flight safety warning panel which tells the pilot what is wrong in words.

Since the T2V-1 is a navigational trainer, the following communications and electronic equipment are provided: ARN 21, ARC 27 or 34, ARA 26 (optional), ARN 14, ARN 18, ARN 12, APX 6 or 25, ARA 25, APN 22 and S2 compass system. An AIP 10 intercom system, which may be transistorized, is included.

Landing gear handle has an over-center downlock position with strong spring loaded tension provided to block jumpout.

The design of the plane's gear provides for a sink rate of 20.8 ft. per sec., more than twice that of the T-33. All gears have five times the energy absorbing capacity of the T-33 gears. The main gear fulcrums have been beefed to spread loads over a greater area than in the T-33.

The main gears are rated at 10,000 lb. each, while the nose gear is rated at 5,000 lb.

All three gears have an internal metering pin in the shock struts which provide a steady increase in load absorption and block jackrabbitting on landing.

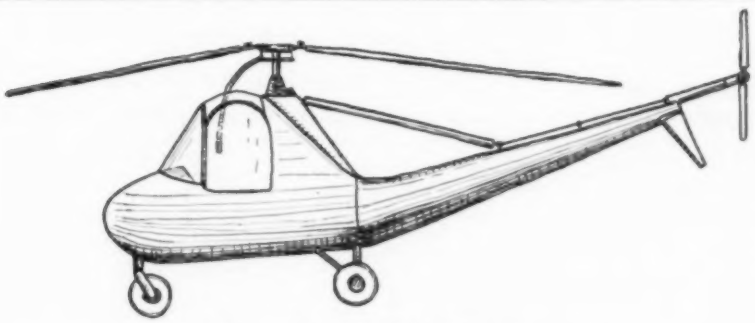
In addition, double acting mechanical linkage gear position indicators are installed on all three gears.

Aileron Boost

A 66W Strato Power pump maintains a constant hydraulic system pressure of 1,500 psi. A cylindrical accumulator without bladder is utilized.

O-ring seals are used throughout the hydraulic system with wide use of teflon backup seals.

The aileron boost system has been redesigned with a 30-to-1 ratio. In ad-



New Czech Helicopter

Second Czech helicopter, a two-seater designed by a group under Jaroslav Slechta at the Research Institute of Aviation, has been demonstrated publicly.

Derived from the Slechta XE-11, a single-seat test vehicle shown in 1951, the new two-seater is a single rotor helicopter of conventional layout. Gross weight is 1,234 lb. Powerplant is a Praga G four-cylinder engine rated at 80 hp.

Claimed performance: top speed, 75 mph.; vertical rate of climb, about 200 fpm.; ceiling, 10,164 ft.; range, 112 mi.

Fuselage is conventional aluminum alloy construction; rotor blades are wood, veneer-covered and finished with a glass fiber material.

The sketch is based on portions of the helicopter visible in a picture taken during Czech Aviation Day at Chocen. No other photographs are available.

electronics engineers:

ARTIST'S CONCEPTION of the IM-99 BOMARC, long-range pilotless interceptor. Guidance and control of the Bomarc is under development by the Westinghouse Baltimore Divisions. (Photo courtesy Boeing Airplane Company)

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dition, a lever cam and torque tube arrangement provides boost-on aileron trim which simultaneously displaces the control column, reminding pilots constantly of the amount of aileron trim used.

An electric tab trims the aileron in boost-off condition.

The emergency hydraulic system pump is capable of indefinite operation in case of primary pump failure.

The plane's oxygen system operates at 1,800 psi. cabin pressure is a 3.3 differential which can be turned on or off in flight. In addition, the pressurization system is designed to prevent fuel backup from the pressurized tip tanks into the main pressurizing system.

A pneumatic escape system utilizes a charged bottle at 1,980 psi. which ejects both canopy and pilot seats. If the canopy fails to eject, pilots can send themselves through it. A canopy breaking structure is incorporated into the top of the ejection seats.

Major structural changes from the T-33 include moving the upper main longerons outboard 2 in. each while the rear pilot seat was raised 6 in. to improve instructor visibility. The canopy was appropriately changed. Structural modifications to accommodate the arrester gear were made.

Aerodynamic speed brakes were retained from the T-33.

Airplanes up to number six are at Lockheed's Palmdale, Calif. test facility. The T2V-1, already has undergone preliminary carrier qualification tests at Inyokern, Calif. Naval Air Station. It is anticipated that planes will be sent to Patuxent River, Md. Naval Air Test Center for evaluation in May or June, while the first carrier flights are expected about the first of next year.

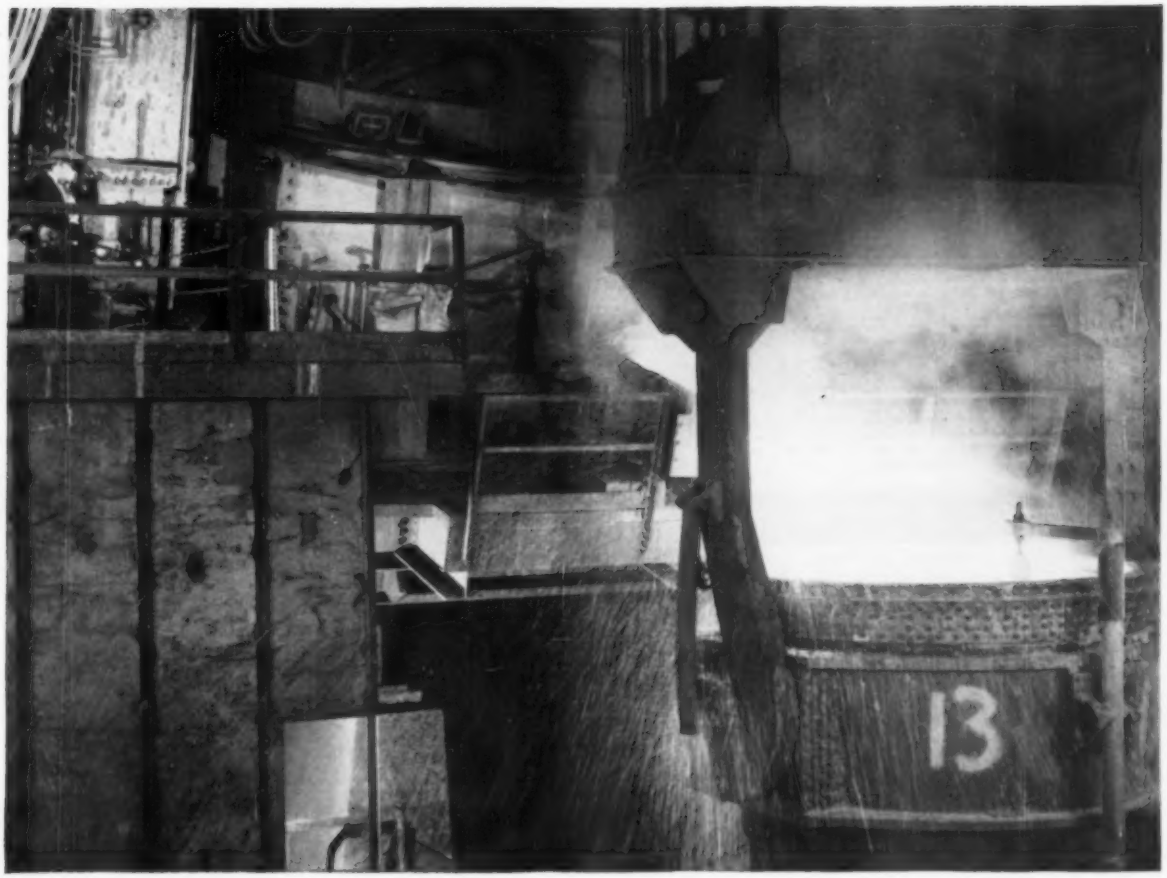
Fastener Costs Jump With Temperature Needs

Doubling the temperature requirement for a simple fastener has resulted in a cost increase of more than 1,000%.

Specific example of this effect of high temperature on aircraft hardware is the price jump from 60 cents to $7 for Camloc Fastener Corp.'s ¼ in. (bolt size) quick operating stressed panel fastener.

Normally used only for temperatures up to 350-500 F, these fasteners must be good up to 900 F for use on Convair's B-58. Future requirements may raise the temperature requirement to 1,400 F.

The main reason for Camloc's price raise is switch to Inconel-X but if demand reaches the million per year mark they may be able to cut cost by one-half, claims R. S. Wolff, vice president of Camloc.



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FROM heat to heat, from bar to bar and from order to order Timken® stainless steel has the uniform chemical composition you need for uniform forgeability. One big reason: we make an average of 70 chemical determinations of every heat.

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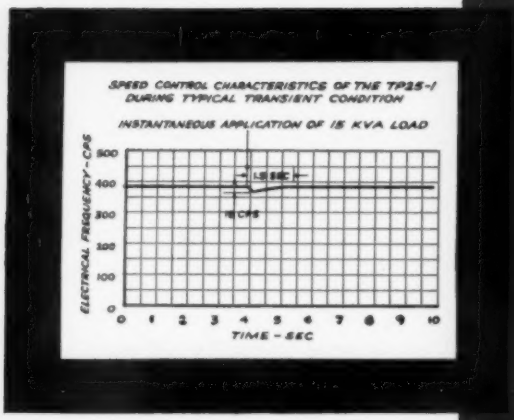

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A new overspeed control permits in-flight resetting if desired.

Tested under simulated aerobatics — speed variation only 1.9% at 9G's while under full electrical load.

This new addition to Stratos' line of Air Turbine Drives brings constant speed into a higher output range. Already fully qualified and flight-proven, dash numbers of the Model TP25 are driving alternators in two of the newest supersonic fighters.

Designed specifically for operation in high performance aircraft the TP25 functions with bleed air inlet temperatures of 900° F at inlet pressures over 450″ HgA, ambient temperatures of 250° F and cooling air temperatures of 210° F. It is not altitude limited, operating to the service ceiling of the new aircraft in which it is installed.

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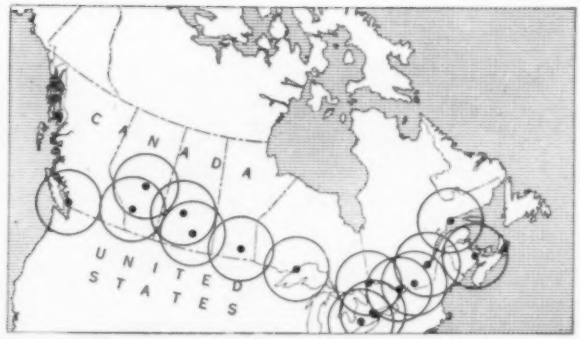


TRANSCONTINENTAL NETWORK of 15 Raytheon Radars (r.) will keep 90% of Canada's air traffic under almost continuous surveillance.

Canada Buys Radar Traffic Control Net

By Philip J. Klass

Canada last week placed an order for a $5 million transcontinental network of radars for civil-military air traffic control that will provide almost continuous coast-to-coast coverage of 90% of the route miles flown in Canada. The Canadian radar network should be operational by 1958.

Raytheon Manufacturing Co., which will supply the Canadian radars, last week told U.S. Civil Aeronautics Administration officials that it could supply a number of similar traffic control radars by 1957, providing the CAA placed its order by the end of this year.

The new Canadian radar network will provide a coverage of approximately 400,000 square miles, the greatest radar coverage of any civil air traffic control organization in the world, according to George C. Marler, Canadian Minister of Transport. The move is part of Canada's efforts to meet the needs of jet operations. It also fits in with Canada's plans to extend IFR (instrument flight rules) to all flights operating in high density areas during fair (VFR) and IFR weather, John R. Baldwin, Deputy Minister of Transport, told AVIATION WEEK.

The Canadian civil radar network will be tied into the military Pine Tree and Mid-Canada radar lines, according to Baldwin.

The radars will be installed at the following locations:

Moncton, Seven Islands, Quebec, Montreal, Ottawa, Toronto, London, North Bay, Fort William, Winnipeg, Regina, Saskatoon, Edmonton, Calgary and Vancouver.

High Altitude Coverage

The huge 40-foot Raytheon radar antenna will make it possible to pick up Constellation-size aircraft at distances of up to 200 miles at altitudes of up to 70,000 feet and is suitable for high-flying jet operations.

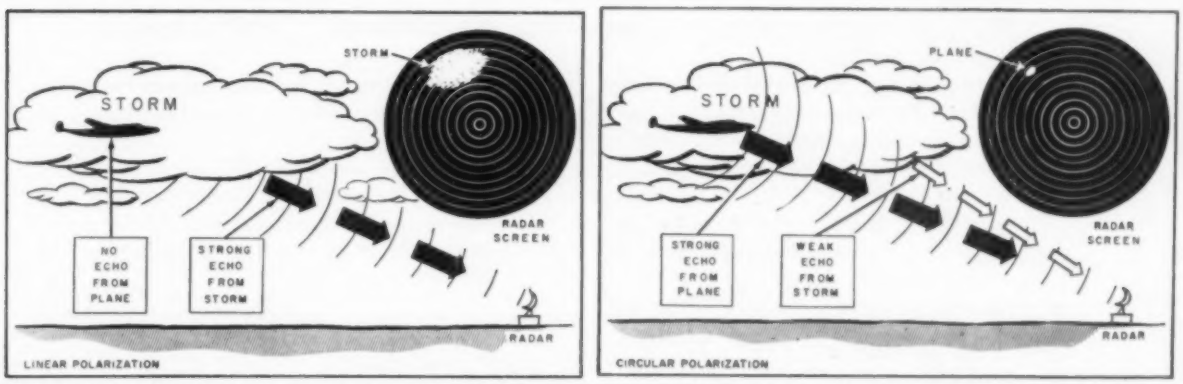
Both range and high-altitude coverage exceed the performance of the AN/FPS-8 long-range surveillance radars now installed at Washington, Chicago and New York for CAA evaluation, according to Raytheon. The Raytheon radar is an outgrowth of the military AN/FPS-19 and a similar set being used on the DEW Line.

The Raytheon radar has growth potential. The present set has a peak power of approximately ½ megawatt. However, by inserting a new device known as an "amplitron" (it resembles a magnetron), peak power can be boosted to four megawatts, Raytheon officials say. This would extend the radar's range against small jet aircraft out to that now possible against large piston-engine craft.

Raytheon claims the Canadian radars are "approximately 1% better than any military radars now in production," but not up to some newer military radars now under development.

Airport-Airways Coverage

Radar information will be displayed on scopes located both in Canadian air route traffic control centers and control towers, which explains the equipment designation—Airport and Airways Surveillance Radar or AASR for short. The set is equipped with moving target indication (MTI) to filter out undesirable radar reflections from ground ob-



CIRCULAR POLARIZATION in new Raytheon radars should reduce clutter which now obscures aircraft blips during heavy rainfall.

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The fastest short-to-medium haul airliner flying today, the new F-27 owes its performance, operating economy, and freedom from vibration to the hushed power of its airline-proven Rolls-Royce propjet engines.

Its high-wing configuration provides panoramic visibility for each passenger. Built in passenger stairway and carry on luggage racks are provided. Low fuselage cuts passenger and cargo-handling time.

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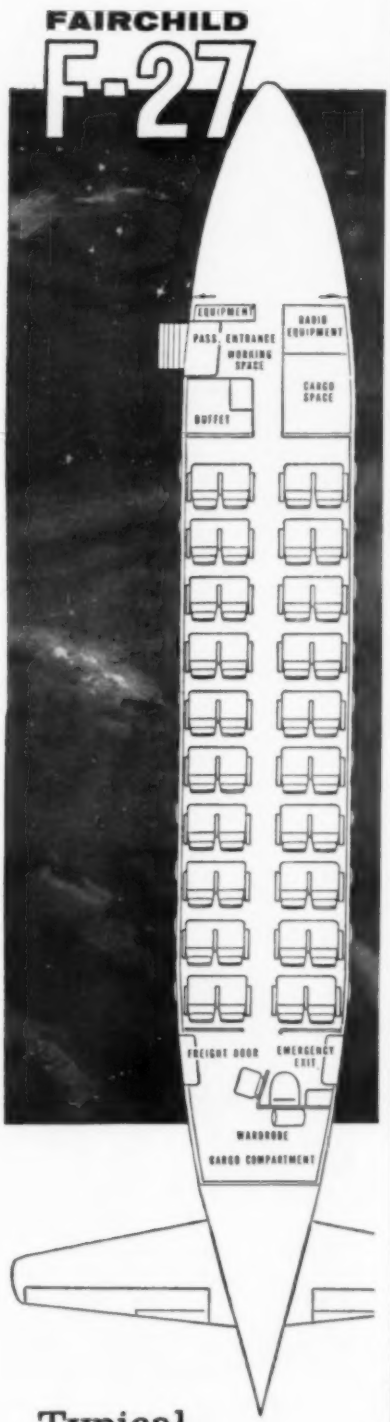
Address inquiries to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine and Airplane Corporation, Hagerstown, Md.



Typical 40-seat airliner layout.

LANDMARKS are "painted" electronically on radar scope, while moving target indicator removes ground clutter.

jects. However, it is provided with electronic circuitry which can "paint" a map of ground landmarks and airways on the scope, when desired.

Raytheon boasts of its circular polarization which it says effectively reduces clutter that obscures aircraft blips during heavy precipitations. Dual equipment and controls will be incorporated to provide standby service in event of malfunctions. Built-in performance checking equipment also is incorporated.

VOR Airways to Proceed

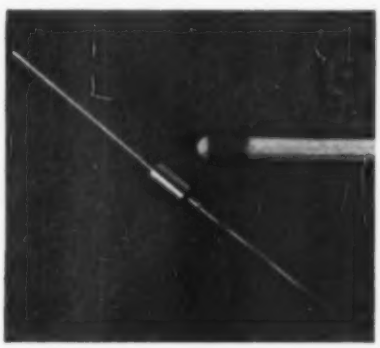
A major portion of the development and production of the radar installations will be carried out in Canada under a subcontract with Raytheon Canada, Ltd., Kitchener, Ontario. This firm is jointly owned by Dominion Electrohome Industries, Ltd., and Raytheon.

The new Canadian radar traffic control network will not change that country's plans to install VOR (omnirange) airways next year, Baldwin told AVIATION WEEK. The Canadian Department of Transport also has ordered four shorter-range Decca radars for installation this year at Montreal, Toronto, Winnipeg and Vancouver airports. When the Raytheon radars are installed, the Decca sets will be transferred to secondary airports.

Technical Highlights

Performance details on the new Raytheon radar are as follows:

- Frequency: 1,250 to 1,350 mc.
- Azimuth beamwidth: 1.6 deg.
- Elevation beamwidth: 6 deg.
- Pulse length: 2 microseconds
- Repetition rate: 400/sec.
- Peak power: ½ to 8 megawatts
- Polarization: Horizontal and circular.



Tantalum Capacitor

Subminiature capacitor, employing new solid tantalum electrolyte, has capacity of 12 microfarads, yet is no larger than the head of a kitchen match. Hermetically sealed unit reportedly experiences only a 5% change in capacitance over temperature range of —132F to 185F, and with minor derating can be used at up to 212F. Application data on the Type 150D Tantalex capacitor is available in engineering bulletin 3520 of Sprague Electric Co., 97 Marshall St., North Adams, Mass.

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P-1294, Aviation Week
1125 W. 6 St., Los Angeles 17, Calif.

FILTER CENTER

▶ **RAF Avionics Officer**—The Royal Air Force has created a new air crew category of air electronics officer, primarily for Britain's V-bomber force. Duties will include operation of airborne avionics, interpretation and evaluation of information obtained, and in-flight maintenance. "The growing complexity of airborne radio and electronic equipment in service aircraft calls for great skill in its operation," says an Air Ministry spokesman. "The success of future air operations will, more than ever before, be dependent on the skill and initiative of the men responsible for this equipment." Flying badge for the air electronics officers will be a single wing with the letters "A.E."

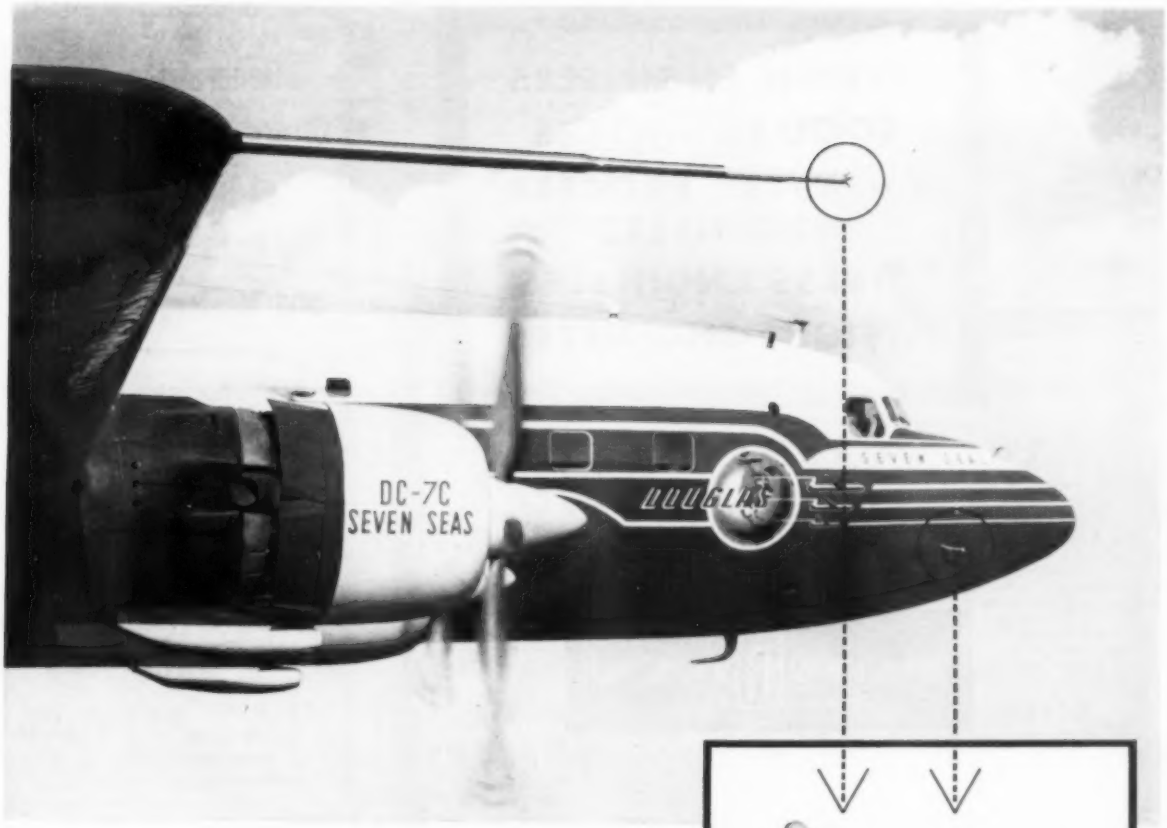
▶ **Decca Evaluation Starts**—Army Signal Corps tests on the British Decca navigation system are scheduled to get under way this month at Ft. Huachuca, Ariz., to evaluate its potential use for liaison aircraft and helicopters. Air Navigation Development Board which recently purchased six airborne Decca receivers from Bendix-Pacific, will participate in the Arizona tests.

▶ **Scientist Defined**—Anyone having trouble telling the difference between a scientist and an engineer may find this definition helpful. Scientist: an engineer who likes poetry.

▶ **Rapid Electronics Growth Predicted**—An $18 billion dollar electronics industry by 1964, 66 percent bigger than

Brought by Bird

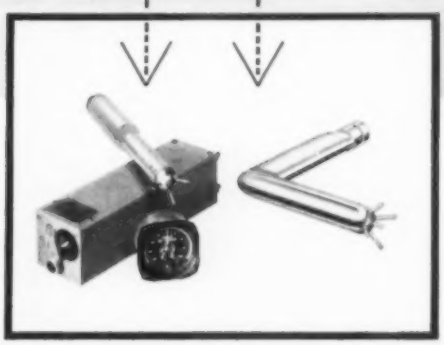
Newest addition to Northrop Aircraft's large computing facility is this analog computer, made by Electronics Associates, Inc. The new computer was flown to the West Coast in a Slick Airways C-46 and put into operation within hours after its arrival.



ANNOUNCING

A CRUISE CONTROL SYSTEM WITH NO MOVING PARTS...

The Giannini-Douglas Differential Pressure Flight Angle Computer



Differential pressure probes *with no moving parts* sense cruise control air data on Douglas Aircraft's newest overseas transport, the DC-7C. The probes are an integral part of a completely new angle-of-attack measuring system, the Giannini-Douglas Differential Pressure Flight Angle Computer, which was designed to have the greatest reliability and longest operating life possible in a cruise control sensing instrument.

In the Giannini-Douglas developed unit, small impact probes are accurately positioned on the head of a short stub boom mounted on the side of the fuselage; or for flight test, on a free airstream boom. The probes are connected to sensitive Giannini pressure transducers which supply electrical signals proportional to air data to a passive network computer having no vacuum tubes. The output of this integrating unit can be fed directly into an automatic flight control system or can be used to activate a panel indicator.

System accuracy in the control range is $\pm 0.1°$ to $\pm 0.2°$ and angle of attack data can be sensed over a range of $\pm 20°$ from Mach 0.3 to 2.0. Less than 0.25 ampere at standard aircraft voltage is required for continuous operation.

Thoroughly proven in wind tunnel and flight test, the Giannini-Douglas Differential Pressure Flight Angle Computer is one more outstanding example of recent advances in aeronautical progress made possible by the ingenuity and skill of today's research and design engineers in the field of avionics.

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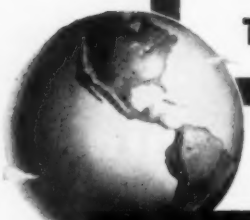

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GENERAL ELECTRIC

the $11 billion racked up in 1955, is predicted by Frank M. Folsom, president of Radio Corporation of America. Calling this prediction a "conservative estimate," Folsom said the anticipated electronics industry growth would be more than twice that of the national economy during the next eight years. Folsom pointed out that 80% of RCA's sales last year stemmed from items which 10 years ago did not exist or were not commercially developed.

▶**L. A. Makes Component Survey**—A survey of electronic components to determine which items the Southern California industry must "import" from the east or midwest, intended to point up opportunities for local manufacturing and expansion in the components field, has been undertaken by the Los Angeles Chamber of Commerce through its Electronic Component Development Committee. Lack of local sources of certain components burdens Southern California electronic equipment makers with increased transportation costs, longer lead time, and higher inventories, the Chamber of Commerce believes.

▶**New High-Speed Computer**—"Datamatic 1000" is the name of a new data-processing system developed by Datamatic Corporation, a jointly owned venture of Minneapolis-Honeywell and Raytheon Manufacturing Co. The machine reportedly can handle 1,000 multiplications, 4,000 additions, or 5,000 comparisons per second and can read-in or read-out at the rate of 60,000 digits per second. Data, inserted by punched cards at the rate of 900 cards per minute, is stored on three-inch wide magnetic tapes. One 2,700 foot reel of tape can store 37.2 million decimal digits, or the equivalent of 465,000 punched cards. New Datamatic will sell for about $1.5 million or rent for about $30,000 to $40,000 per month.

▶**Transponder Evaluation Report**—An operational and technical evaluation of the air traffic control transponder system, conducted by the Civil Aeronautics Administration, is described in newly available report, PB 111776. Copy of report, entitled "Evaluation of the Rho/Theta Transponder System" is available for $2.25 from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C.

▶**A Whopper**—A $46 million contract for undisclosed type of airborne avionics equipment has gone to Raytheon Manufacturing Co. Observers speculate that the order, a whopper by any standards, is for airborne radar or navigation systems. Total Raytheon government backlog now runs $150 million.

NEW AVIONIC PRODUCTS

Components & Devices

• **Miniature indicator lamp assembly,** measuring only ⅜ in. dia. x 1⅛ in. long, including a ⅛ in. front panel projection, can be used with printed-wire boards. Vibration proof design eliminates need for lock nuts and washers, speeds assembly. Up to 1,000 indicator lamps can be installed on a single square foot panel. Circon Component Co., Santa Barbara Municipal Airport, Goleta, Calif.

• **Encapsulated transformers,** employing novel coil construction and encapsulation process, reportedly reduces temperature rise by 50% over comparable units, permitting operation in ambient temperatures of 125C. Transformers are available to customer's specifications. Electro Engineering Works, Inc., 401 Preda St., San Leandro, Calif.

• **High temperature servo motor-generator,** Type MG-3088, operates continuously at 140C and has no-load speed of 19,600 rpm. The size 11 motor operates from 26 v., 400 cycle input. An integral drag-cup tachometer

Royal
AMPHIBIAN NEWS

Notes on America's outstanding utility amphibian for business flying and charter service operation

3 NEW ROYAL GULLS REPLACE SINGLE ENGINE PLANES TO HELP SPEED "DEW" LINE CONSTRUCTION

JACK GRAHAM, right, manager of Timmins Aviation Ltd., and Max I. Black, manager of Royal Aircraft, check map of remote areas over which Geolaire's new Royal Gulls will be flying.

Montreal, Canada—Three Royal Gulls will be used in support of the DEW line (Distant Early Warning) system which is currently being constructed to provide a primary source of radar warning for the defense of continental North America.

Geolaire, Ltd., with headquarters in Toronto, recently purchased the three **twin-engine** amphibians from Timmins Aviation Ltd., Royal Aircraft's Canadian distributor. The planes will be used to transport personnel and materials needed in establishing the radar centers.

Geolaire, Ltd. selected the Royal Gull as the most suitable aircraft for the assignment because of its load carrying capacity, long range and amphibian features. Formerly, **single-engine** float planes were used wherever water landings were possible. But, as construction moved north, it became apparent that it was too dangerous to rely on this type of plane.

EXPECTS GULLS TO BECOME POPULAR AIR WORK-HORSE

When in Milwaukee to arrange delivery details on the Royal Gulls for Geolaire, Jack Graham predicted the Gulls would play an important role in many businesses.

In his opinion, the Royal Gull will find wide usage among mining groups, surveying crews and resorts using charter air service. He also feels that these planes are ideal for ferrying businessmen and as liaison ships for construction projects in distant areas.

He cited the Gull's rugged construction and proven performance despite temperatures as low as 30 degrees below zero.

Timmins Aviation, he added, intends to stock all expendable parts in Montreal to provide ready service for all Royal Gulls operating in the Dominion.

If you'd like to know how the Royal Gull fits into your air-transport picture, write direct —

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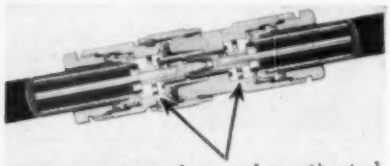
delivers 0.35 v/1,000 rpm., has 23 mv. residual voltage, 500 ohms output impedance and 1% linearity up to 8,000 rpm. The combination has an inertial of 2.85 gm.-cm.², measures 1.03 in. dia. x 2.156 in. long, and weighs 4.6 oz. John Oster Manufacturing Co., Avionic Div., Racine, Wisc.

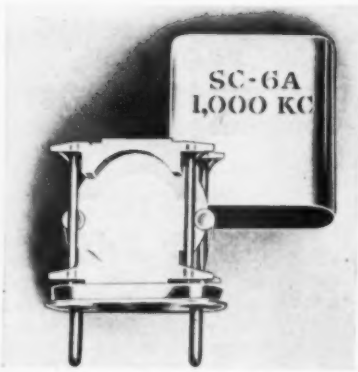
• **New RF connector design** features a contact captivated within the connector shell for assured circuit continuity under extreme temperatures. Contacts re-



Cross-section of mated captivated contact RF connectors. Contacts remain in fixed position when extreme temperature changes may cause cable shrinkage.

portedly remain fixed in position despite shrinkage of the connector's dielectric material. New principle is incorporated in Series N and HN plugs and panel jacks. American Phenolic Corp., Chicago 50, Ill.

• **Ruggedized crystals,** in new Kel-F mounting designed to meet or exceed MIL-C-3098B, are now available in



production in frequency range of 800 to 2,000 kc. Application data on the new SC-6A crystals are available from Standard Crystal Co., 1714 Locust St., Kansas City 8, Mo.

• **Extruded Teflon coated wire,** unaffected by ambient temperatures of −90 C to 250C, is available in 14 standard colors and various combinations of 1 or 2 color stripes, in sizes ranging from 10 to 26 AWG. Hitemp Wires, Inc., Windsor Ave., Mineola, N. Y.

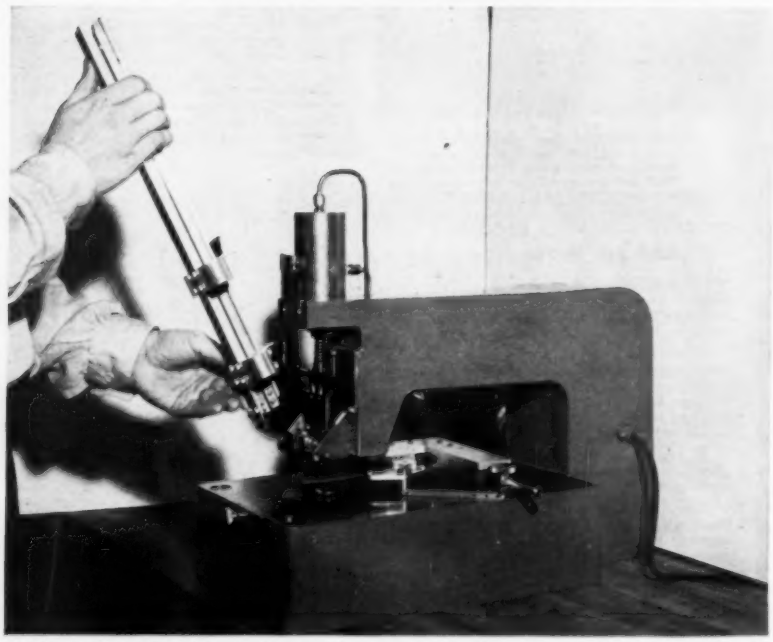
• **High-accuracy resolver,** Size 11, with total functional error of 0.01%, has high input impedance permitting operation from 110 v., 400 cycles. New resolver can operate up to 70,000 ft. altitude without pressurization. Diehl Manufacturing Co., Finderne Plant, Somerville, N. J.

• **Miniature push-to-engage connector,** called "Minicon-X", is mated merely by pushing two connectors together,

can be disconnected with a quarter turn of the mating parts. New connector is available in 20 different types. Nugent Electronics Co., 621 East 8th St., New Albany, Ind.

• **Hysteresis synchronous motors,** new miniature line for instrumentation and use in gyros, can be supplied with 8,000, 12,000 or 24,000 rpm. speeds. J. B. Rea Co., 1723 Cloverfield Blvd., Santa Monica, Calif.

General Mills Designs Autofab For Short Production Runs



SHORT-RUN AUTOFAB, semi-automatic component placement machine, is suitable for avionics production.

Short-run Autofab, a semi-automatic machine specifically designed for mechanized component placement in small production runs, has been announced by General Mills, Inc.'s Mechanical Division, Minneapolis. (The firm also makes a fully-automatic 20-station Autofab for high production runs, as described in AVIATION WEEK, Mar. 21, 1955, p. 60.)

In the Short-run Autofab, the printed wire board is inserted manually. This automatically starts the mechanized component insertion cycle. The component leads are automatically trimmed to the required length just prior to insertion in the board, after which the leads are automatically crimped. The component inserting tool and lead crimping mechanism are easily and quickly changed, and the machine can be switched from one component to another in less than a minute, according to General Mills. Components are fed into the machine from a clip-on magazine designed for rapid loading from standard automation packs. An alternate attachment permits use of taped components.

The current model is designed to handle cylindrical components, ranging from ¼ to 1¼ in. in diameter and from ⅜ to 1¼ in. long. The machine can accommodate printed-wire boards ranging from ⅛ to ¼ in. thick.

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a decade of **POST WAR SERVICE**

AIR TRANSPORT FACTS AND FIGURES

17th EDITION, 1956

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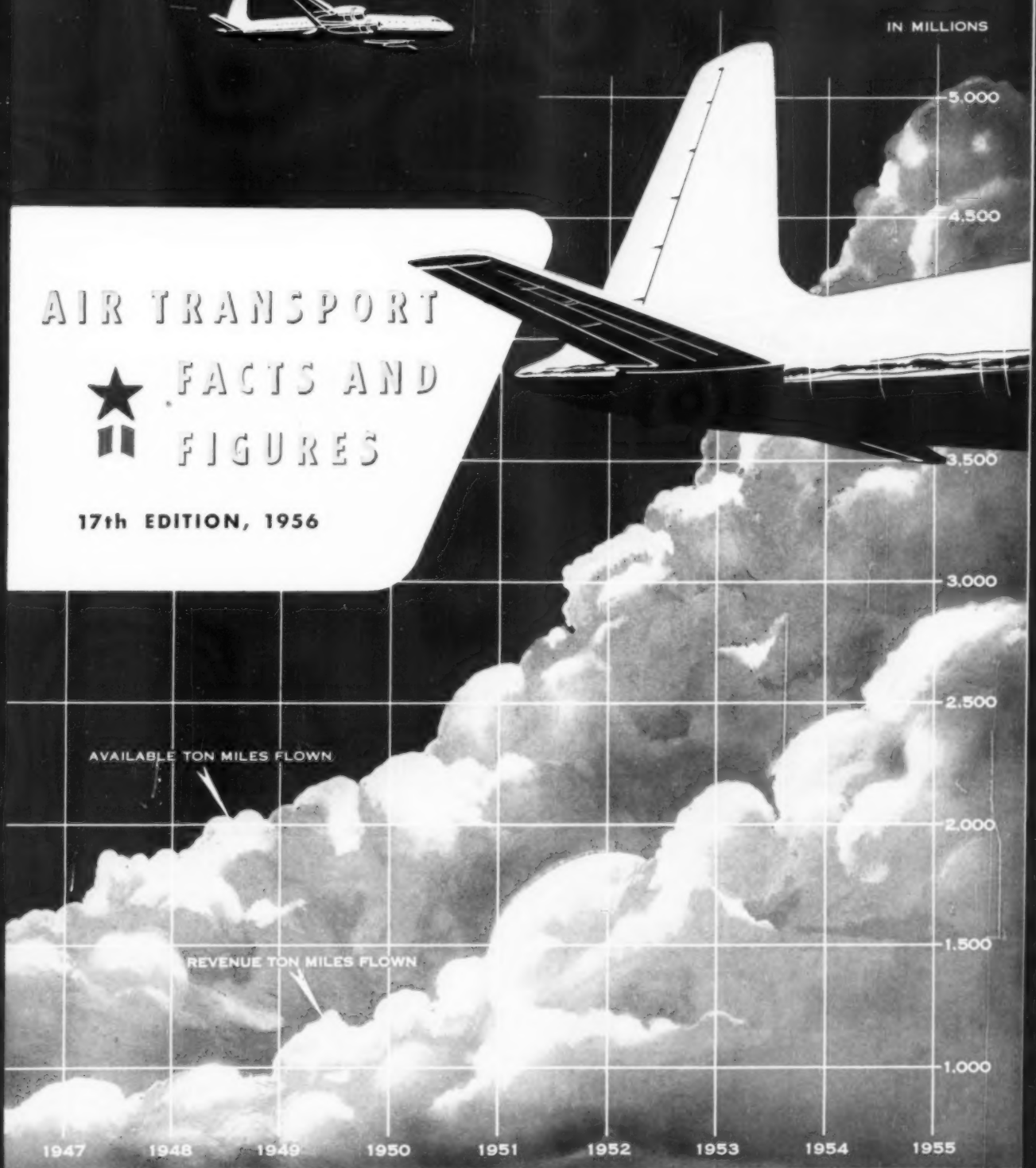


The President's Message

The year 1955 marked for the scheduled airlines of the United States the completion of a decade of service since the end of World War II. During that decade, the American-Flag airlines evolved into the most competitive, the most efficient and the most useful air transport system in the world.

That progress was achieved by private enterprise operating under a Federal law which obligates scheduled air transport to the public service. By law as by policy, the aim of the certificated, scheduled airlines of the U. S. is a comprehensive, flexible air service for the country as a whole.

As general measures of increased usefulness, it can be noted that the industry offered 4 times as many available ton miles in 1955 as in 1946; that air service was extended to many communities which had never previously received its benefits; that new fleets of airliners were introduced; and that the level of the average air fare nevertheless stood in 1955 just about where it stood in 1938. In terms of 1938 dollars, air fares actually have been cut by 60 per cent.

All branches of the family of the scheduled airlines contributed during the decade to the growing usefulness of scheduled air transport:

- The country's great domestic system undertook two equipment revolutions, underwent drastic route reshufflings, developed greatly increased competition, and emerged virtually subsidy free, despite financial crises shortly after World War II.
- The international and overseas operators, competing with one another as well as with heavily subsidized foreign-flag systems, webbed a war-torn world with air service; undertook two equipment revolutions; drastically cut international air fares; and emerged with subsidy amounting to only 3.6 per cent of gross revenues in 1955 as distinct from an estimated 13.8 per cent in 1951.
- The whole system of local service airlines came into being to bring a comprehensive system of regularly scheduled air service to America's important intermediate cities for the first time.
- The Alaskan and Territorial airlines proved to be indispensable to communities whose existence would have been threatened by lack of transportation or whose progress would have been retarded by dependence upon slow surface transportation.
- The fledging helicopter operators came into being to begin the fruitful experiment in regular helicopter schedules in the metropolitan areas of New York, Chicago and Los Angeles.

In 1955, two developments were particularly significant for the industry, and for the country which it serves:

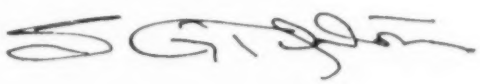
- Congress awarded permanent certification to the local service airlines.
- The domestic trunkline and international operators committed themselves to spend at least $1.3 billion on new equipment, including jets. On some routes, airliners powered by propjet engines were actually placed in service during that year.

The progress is the last decade has been impressive; far greater progress is expected in the years ahead. But problems as well as opportunities lie ahead.

One problem is air traffic control. The airline are only one user of the country's vanishing air space. But they share with other users the concern that today's methods of air traffic control will not be suitable for the numbers and speed of tomorrow's aircraft. However, the problem can be solved. The country has the ability to provide an air traffic control system adequate for its future needs.

Another problem concerns equality of regulation. The country's air service has been developed under a method of close regulation as to the fitness, willingness and ability of individual companies. The standards for authorizing routes and services have been the standards of public convenience and necessity rather than private gain. The public should be made aware that efforts to subvert the principles of regulated competition—upon which future progress depends—are being made.

Granted a stable regulatory climate, what lies ahead is a transportation revolution for the United States. Improvements in short-haul as in long-haul services will bring about new and better patterns of living for the American people.



a decade of POST WAR SERVICE

This index covers material demonstrating the increasing use of U. S. scheduled air transportation in the post war years. Revised data filed by the scheduled air transportation in the post war years. Revised data filed by the scheduled air carriers with the Civil Aeronautics Board and the records of the Interstate Commerce Commission served as the major sources of the statistics.

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Definition of Terms

Passenger Miles and Ton Miles

AVAILABLE SEAT MILES FLOWN. Total seat miles available for sale in scheduled service.

AVAILABLE TON MILES. Total ton miles of lift capacity available for sale in scheduled and charter service.

CHARTER FLIGHT. Transportation of passengers or property on other than scheduled and designated extra section flights.

EXPRESS TON MILE. A ton of express flown one mile.

FREIGHT TON MILE. A ton of freight flown one mile.

PASSENGER MILE. One passenger flown one mile.

PASSENGER LOAD FACTOR. The percentage of available seat miles actually sold in scheduled service.

PASSENGER TON MILES. Passenger miles converted to ton miles. (See definition of revenue ton miles.)

REVENUE PASSENGER MILES. The number of fare paying passengers flown times the length of trip in miles. This is the amount of available seat miles sold.

REVENUE PLANE MILES. Aircraft miles flown in scheduled service.

REVENUE TON MILES. The ton miles sold in scheduled and charter service. In the construction of this traffic measure passenger miles are converted to ton miles on the basis of about 10 to 1. That is, ten passengers with allowable free baggage are accepted as equalling one ton.

SEAT MILE. One passenger seat, filled or unfilled, flown one mile.

TON MILE LOAD FACTOR. Percentage of available ton miles sold in scheduled and charter service.

U. S. MAIL TON MILE. A ton of mail flown one mile. The statistic includes priority air letter mail and air parcel post. Since the beginning of the experiment on flying first-class (three-cent) mail by air, such non priority mail has also been included in U. S. Mail Ton Miles.

Revenues and Profit and Loss

EXPRESS REVENUE. Revenues accrued from the carriage of express.

FREIGHT REVENUE. Revenues accrued from the carriage of freight.

INCOME TAXES. Federal income taxes.

NET INCOME BEFORE TAXES. The net income to the business from all transactions. In addition to airline net operating income this includes such items as net profit from the sale of equipment, proceeds from the ownership or sale of investments, revenues of separately operated divisions, revenue from the rental or contractual operation of aircraft, and profit or loss on the exchange of foreign currency.

NET OPERATING INCOME. The total operating revenue from air transportation services less the operating expenses (see definition of Operating Expenses). Net Operating Income is before taxes and interest charges and does not include the nonoperating items in Net Income Taxes (see above).

NET PROFIT OR LOSS. Net income after Federal Income taxes—the amount available for dividends or investment in the business. This figure is subject to change because of the later adjustment of some accounting transactions and through revision of mail rates and subsidy by regulatory action.

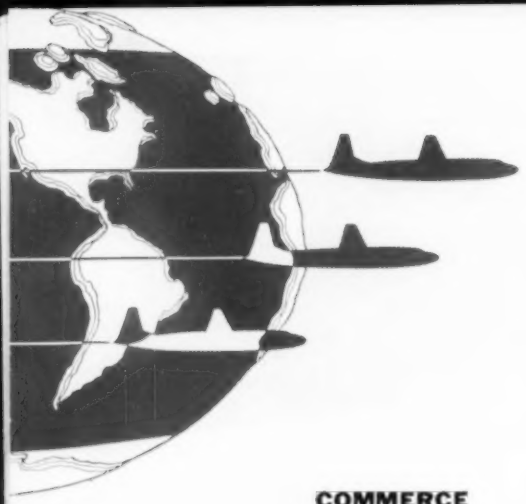
OPERATING EXPENSES. The expenses incurred in the conduct of the business except for such items as debt financing and other non-operating items identified above in Net Income Before Income Taxes.

OTHER REVENUE. All other revenues, including excess baggage, chartered services, foreign mail, penalties for failure to cancel reservations, service charges on non-revenue transportation of employees and special services such as photography and crop dusting.

PASSENGER REVENUES. Passenger revenues from scheduled operations.

PUBLIC SERVICE REVENUES. Payments by the Federal Government to insure air service to communities in the United States and its territories which could not otherwise afford it; to maintain essential international air routes which are not yet self-supporting; and to develop helicopter service.

U. S. MAIL REVENUE. Service revenue for the transportation of mail. This is the amount paid by the Post Office to purchase air transportation for mail, and is not subsidy.



COMMERCE

Under the system of regulated competition, established by the Civil Aeronautics Act of 1938, the scheduled airlines of the United States have provided the country with the most competitive, the most efficient and the most useful airline system in the world.

Here are some of the measurements of the industry's expanded usefulness to the commerce of the country since 1938:

> The number of certificated airlines has risen from 22 to 56 and the number of employees from 13,300 to more than 118,000;
>
> the number of passengers from 1,526,000 to more than 41,623,000.

In terms of passenger miles, the domestic and international scheduled airlines increased from 533,052,000 in 1938 to 24,463,158,000 in 1955, an almost phenomenal rise of 4,489 per cent.

There were 284 daily schedules available in 1938, and more than seven times that number in 1955. Speeds of available equipment increased to as much as 360 miles an hour in 1955 as against 200 in 1946 and 180 in 1939. Range of equipment has also increased. Plans for the industry to put still faster planes in service make news almost daily.

A proof of the value the American public has placed on modern air transportation since World War II is that it has increased its spending on airline travel at a greater average yearly rate—18 per cent annually—than it has on any other type of personal spending.

Today scheduled air transportation is offering a post-war luxury service at pre-war average fare levels, which are still declining despite rising costs (in terms of 1939 dollars, it can be said that fares have been cut 60 per cent). In fact, domestic air coach and air tourist fares are lower than 1939 fares, although today's air coach and air tourist services are superior to 1939's first-class services. International air fares in 1955 were down by about 21 per cent in comparison with 1939.

Comparing 1955 with 1954, scheduled air transportation alone was responsible for about a 3 per cent increase in the domestic intercity passenger traffic of all commercial transportation facilities in 1955. Domestic airline passenger traffic in 1955 increased about 3.2 billion revenue passenger miles over 1954 while the surface carrier figures went down about 1.8 billion.

For the entire industry—domestic trunklines, local service lines, international carriers, territorial airlines, helicopter services and the Alaskan Carriers—revenue passenger-miles went up from 20,605,058,000 in 1954 to 24,338,000,000 in 1955, a gain of 18.1 per cent.

At the same time, passenger revenues for the industry rose from $1,166,554,000 in 1954 to $1,356,435,000 in 1955, an increase of 16.3 per cent. Public service revenues, or subsidy, on the other hand, dropped about 42 per cent from $66,233,000 in 1954 to $38,407,000 in 1955, or 2.4 per cent of total revenues.

Total revenues for the industry went up from $1,420,847,000 in 1954 to $1,610,557,000 in 1955 for a gain of 13.35 per cent.

Mail ton miles recorded for the industry went up from 118,293,000 in 1954 to 142,209,000 in 1955, an increase of about 19 per cent, while foreign mail ton-miles rose nearly 7 per cent from 7,338,000 in 1954 to 7,842,000 in 1955.

Express ton-miles for the entire industry totaled 51,075,000 in 1955, up 24 per cent from the 41,175,000 total in 1954, while the freight ton-mile total rose from 236,623,000 in 1954 to 280,938,000 in 1955 for an increase of 18.7 per cent.

During 1955, the industry started the biggest equipment drive in its history. Positive orders and public statements of intention to order included 135 pure jet transport planes at a total cost of $761,300,000; 135 turbo-prop airplanes—aircraft with jet engines turning propellors—at a total cost of $265,000,000 and 55 piston-engine airplanes at a total cost of $137,300,000.

In addition, announced equipment-buying plans totaling another $146,000,000 will probably include orders for all three types of airplanes. The total of $1,309,600,000 does not include an option held on 30 additional turbo-prop airplanes.

DOMESTIC TRUNKLINES

The domestic trunklines, which are virtually subsidy-free, set new records in 1955. Revenue passenger miles were up nearly 18 per cent; gains of 25.2 per cent in coach traffic and 14.5 per cent in first class. Revenue ton miles gained 20 per cent; express ton miles increased 25 per cent and freight ton-miles 22 per cent. Mail traffic was up almost 9 per cent.

Total revenues were up, too, with a gain of 16 per cent which for the first time placed the domestic trunklines total operating revenue well above the billion dollar mark. Passenger revenues alone showed a gain of more than 16 per cent and accounted for almost 97 per cent of the total revenues. Public service revenues dropped more than 25 per cent. (Most of the domestic trunklines are subsidy free, with the result that subsidy for the trunklines as a whole amounted to only one quarter of one per cent of total revenues.)

INTERNATIONAL

During the 12-month period ending June, 1955, American-Flag airlines recorded gains at 24.3 per cent in the number of passengers leaving the country and 21.2 per cent in incoming passengers, while foreign-flag airlines gained 15.9 per cent in passengers departing from the U. S. and 8.9 per cent in passengers arriving in the United States. June was the first month in which more people flew to Europe than went by ocean vessels.

During the 12-month period ending in June, 1955, a total of 1,177,546 people arrived in this country via air, of which 808,999 came via American-Flag airlines and 368,547 used foreign-flag airlines. In these same twelve months, 1,028,264 passengers left the United States by air, 698,523 using American-Flag airlines and 329,741 flying under a foreign flag.

In that period coach or tourist-class service continued to gain until it outnumbered first-class traffic approximately two to one.

During 1955 American-Flag airlines ordered jet transports from Boeing and Douglas which are presently scheduled for international operations in 1959.

Subsidy payments dropped from $28,500,000 to $7,600,000, or 73 per cent. The latter figure is 2% of the 1955 total revenues.

LOCAL SERVICE

During 1955, Congress, recognizing the value of the local service airlines in the national transportation picture, directed the CAB award them permanent certificates.

The local service airlines have increased their revenue passenger miles more than 77 times since 1946, their first full year of operation. In 1946 they carried 25,000 passengers; in 1955 the number reached almost 3 million.

In the five-year period ending with 1955, the local service airlines more than tripled their revenue passenger miles, while increasing their passenger revenues four times and their total commercial revenues more than three times. Their percentage of public service revenues to total revenues has also declined; in 1954 public service revenues amounted to 57 per cent of their income. In 1955 the corresponding figure was approximately 37 per cent.

HELICOPTER CARRIERS

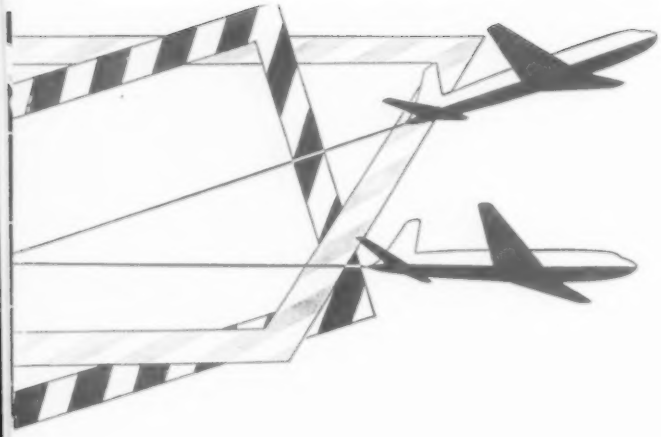
The helicopter airlines in the five years ending with 1955 have more than doubled the available ton miles of service offered. They increased their revenue passenger miles almost 3½ times in 1955, compared with 1954. Their freight ton miles in this same period showed an increase of 26 per cent and their express ton miles rose more than 167 per cent. Total revenues were up 12.3 per cent.

ALASKAN CARRIERS

The Alaskan carriers showed increases in all forms of traffic, with revenue passenger miles up 26.9 per cent, mail ton miles up 10.8 per cent and combined express and freight ton miles up 21.7 per cent. Total revenues were up almost 15 per cent.

TERRITORIAL AIRLINES

The territorial airlines increased their revenue passenger miles in 1955 over 1954 7.4 per cent; their mail ton miles 5.3 per cent and despite a drop in freight ton miles their total revenue ton miles were up 8.4 per cent. Total revenues were up 13.8 per cent.



MAIL

Back in the days when commercial scheduled air service was born, air mail was the major source of revenue for the country's young airlines. Scheduled air service then was in fact designed for the sole purpose of speeding the mails.

Today, however, payments for carrying the mail are only 4.5 per cent of the revenues for the entire scheduled airline industry. In addition, air mail today is a source of revenue for the Post Office.

The total of postal revenues taken in by the Government on domestic air mail services fiscal 1955 was $142,571,000. Of that amount, the Post Office paid the airlines $33,719,567.

In fiscal year 1955 it is estimated that domestic air mail showed a return of $20,268,000 or 14.2 per cent on a gross revenue of $143,000,000. International air mail had a return of $12,161,000.

Over the past four years, the Post Office had a return of $47,598,000 on domestic air mail, or 12.4 per cent on a gross of $383,413,000. International air mail in the same period showed a return to the Post Office of $26,800,000.

In addition to carrying air mail, the airlines and the Post Office are now conducting an experiment in carrying three-cent mail by air on a space-available basis whenever carriage by air saves time over and costs no more than surface transportation.

At the present time about 4 million pieces of first-class mail are moving every day on a space available basis by air. Under the first-class mail experiment, a part of the national transportation evolution now going on in the United States, about 21,000 tons of three-cent letter mail is being moved annually or about 6 per cent of the 17 billion non-local first-class mail handled yearly. The Post Office has estimated that the delivery of this mail is as much as 48 hours faster than when carried by surface transportation.

While the experiment is succeeding, the airlines are not certain that they are being compensated adequately for the service (in the first twelve months of the experiment they received $1,830,000 for carrying the mail between the points affected while returning $29,500,000 to the Post Office). But the main point is that the experiment is proving that the lines have the airlift capacity to provide the service.

This new service does not infringe upon six-cent air mail service—a superior service that gets special treatment from the moment of mailing.

AIR NAVIGATION AND TRAFFIC CONTROL

The people of the United States are running out of one of their most vital resources—the airspace. The sky, which once seemed to be limitless, is now in short supply; it has become a critical commodity in this day of ever-increasing numbers of air transports, military aircraft and numerous classes of business and private aircraft, many flying at ever-increasing speeds.

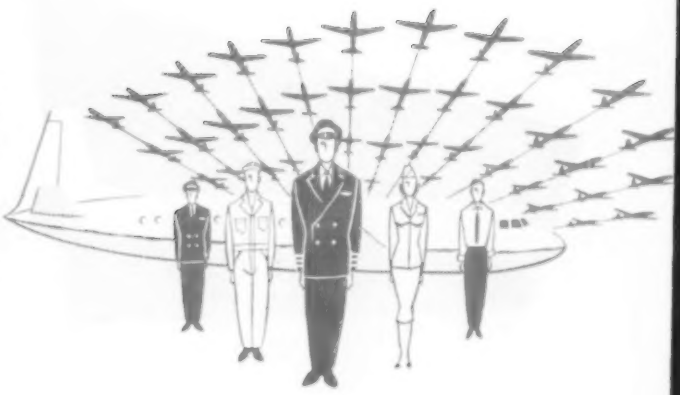
But the demands for airspace do not stop with the multiple types of aircraft using it. The Army requires airspace to conduct artillery firing, the television industry seeks more airspace for transmitting towers, and the Atomic Energy Commission must have its share of the airspace for vital experimental and test purposes.

The problem resulting is how to control the users of the airspace so that each will have his fair share.

Today's method of controlling air traffic is not only outmoded, but it will be seriously inadequate tomorrow. No system yet exists which will adequately control tomorrow's planes in tomorrow's numbers flying at tomorrow's speeds. The attack on this problem should be two-pronged. First, steps should be taken to install at a greatly accelerated pace the air traffic control tools already in existence. Radar is one such tool for bolstering the present safe but entirely inadequate system. And simultaneously, steps should be taken to begin the development of a bold, new revolutionary system for the future. The end product of the new system should be fully automatic air traffic control, which has the feature of being gradually integrated with, and also compatible with, our present system.

The Federal Government at both the Congressional and Executive level recognizes the nation's air traffic control needs. An aviation subcommittee of the

Senate Committee on Foreign and Interstate Commerce, known as the Monroney Committee, has undertaken a study which includes an examination of the nation's current air traffic status and future requirements. The Bureau of the Budget has completed a report on the subject and President Eisenhower has appointed Edward Peck Curtis as a Special Assistant for Aviation Facilities Planning to head an attack on the problem of an air traffic control system suited to the country's future needs.



NATIONAL DEFENSE

One of the principal contributions of the scheduled airlines is in the large, modern fleet they maintain in being. That fleet contains aircraft essential to the national defense and which, if they were not provided by the airlines, would have to be built and maintained on a "stand-by" basis by the taxpayers.

The large commitments for jet airliners planned to start to go into service beginning in 1958 are thus as significant to the defense as to the commerce of the United States. The jetliners will represent defense contributions by airlines which not only, as a group, are free of subsidy but which out of their own funds are able to create an active fleet reserve for the military.

Apart from the future contribution represented by the jetliners, the scheduled airlines today stand ready to aid in any national emergency with the largest Civil Reserve Air Fleet (CRAF) the world has ever known—a fleet composed of more than 45 per cent of the air transport industry's biggest, fastest and latest airliners now flying our domestic and international routes. This airlift capacity costs the government nothing, for the contractual arrangement involves no charge to the government unless there is an emergency.

The CRAF program is based on experience and know-how and proven performance born of lessons learned in World War II, the Berlin Airlift and Korea. The CRAF fleet, available on 48-hour notice, is the result of a joint plan worked out by the Department of Defense, the Department of Commerce and the operators of our civilian air transportation system. The fleet, which represents initial investments estimated in the neighborhood of $400,000,000 in aircraft equipment, would cost the taxpayers $300,000,000 annually if it were maintained and operated by the government on a "stand-by" basis.

The present fleet has an airlift capacity estimated at 566,000 available ton-miles an hour. But according to the Defense Air Transport Administration, which is charged with allocating the aircraft on the basis of the proposed 1956-57 program, the above figures will be revised upward to around 797,000 ton-miles an hour by including more of the bigger and faster planes.

In addition, the CRAF program is to include a War Air Service Pattern for the remaining civil airliner fleet, which is now being worked out to speed the flow of civilian traffic vital to the national defense.

As to their peacetime usefulness to the military, the scheduled airlines in 1955 provided over 843,900,000 passenger-miles of transportation to the various military agencies for their official travel. Through the Military Bureau of the Air Transport Association in Washington, D. C. and its offices throughout the country, the scheduled airlines are constantly serving peacetime requirements of the military departments.

During 1955, by the use of air travel, the Department of Defense realized a saving of 20,165,301 man-hours of productive time of their personnel. Converting the saving to dollars (in terms of per diem payable and the base pay of a private), the man-hour saving represented a net gain to the U. S. Government of $9.8 million.

The scheduled airlines have established over 50 offices at military installations throughout the country called Joint Airlines Military Traffic Offices (JAMTO's). These offices assist in making arrangements for the prompt and efficient movement of personnel and cargo. Over 30,000 military personnel per month have availed themselves of these services for their official and personal travel requirements.

AVAILABLE SERVICE AND UTILIZATION

U. S. Scheduled Airline Industry, 1947-1955 (In Millions)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Trunk Airlines									
Available Ton Miles Flown	1,209.7	1,357.9	1,517.4	1,684.1	1,974.0	2,399.3	2,893.3	3,314.1	3,882.7
Revenue Ton Miles Flown	689.1	706.2	809.0	963.2	1,204.7	1,413.5	1,644.3	1,862.0	2,190.6
Ton Mile Load Factor (%)	56.97	52.01	53.31	57.20	61.02	58.91	56.83	56.18	56.42
Available Seat Miles Flown	9,152.4	9,980.2	11,117.7	12,385.6	14,672	18,068.1	22,114.8	25,729.9	29,978.6
Revenue Passenger Miles Flown	6,016.3	5,822.4	6,570.7	7,766.0	10,210.7	12,120.8	14,297.6	16,288.4	19,205.2
Passenger Load Factor (%)	65.73	58.34	59.10	62.70	69.59	67.08	64.65	63.31	64.06
Revenue Plane Miles Flown	311.9	316.3	323.2	327.1	362.5	411.4	467.0	497.2	563.1
Local Service Airlines									
Available Ton Miles Flown	14.9	31.5	46.4	62.4	81.5	96.2	109.3	115.2	121.9
Revenue Ton Miles Flown	4.7	9.1	14.3	20.9	31.6	36.1	40.7	48.4	55.0
Ton Mile Load Factor (%)	31.87	28.92	30.93	33.51	38.79	37.53	37.28	41.65	45.12
Available Seat Miles Flown	155.5	323.9	477.9	599.2	774.7	905.4	1,013.6	1,092.9	1,161.3
Revenue Passenger Miles Flown	46.4	87.9	134.7	188.8	289.6	339.2	390.9	461.2	523.3
Passenger Load Factor (%)	29.85	27.14	28.18	31.51	37.39	37.46	38.56	42.20	45.06
Revenue Plane Miles Flown	10.1	18.0	24.5	33.0	38.0	41.5	45.6	48.7	51.0
Territorial Airlines									
Available Ton Miles Flown	8.3	9.1	10.1	10.9	13.8	14.2	15.9	15.7	16.1
Revenue Ton Miles Flown	4.9	5.2	5.3	5.8	6.6	7.0	7.4	7.7	8.8
Ton Mile Load Factor (%)	59.91	57.12	52.47	52.75	47.86	49.49	46.70	49.30	54.27
Available Seat Miles Flown	65.9	81.0	91.3	100.1	119.0	124.1	134.6	134.5	134.7
Revenue Passenger Miles Flown	46.8	52.9	52.6	57.7	65.8	67.9	71.8	72.7	78.1
Passenger Load Factor (%)	71.10	65.28	57.19	57.66	55.27	54.72	53.37	54.04	57.99
Revenue Plane Miles Flown	3.1	3.6	4.0	4.3	5.0	5.4	4.9	4.7	4.6
Helicopter Airlines *(in thousands)*									
Available Ton Miles Flown	14	108	142	189	185	181	350	403	438
Revenue Ton Miles Flown	3	28	46	63	71	75	129	152	194
Ton Mile Load Factor (%)	18.43	25.93	32.39	33.33	38.38	41.44	36.86	37.71	44.35
Available Seat Miles Flown	.....	.....	.....	.....	.....	.....	191	716	1,708
Revenue Passenger Miles Flown	.....	.....	.....	.....	.....	.....	26	183	628
Passenger Load Factor (%)	.....	.....	.....	.....	.....	.....	13.61	25.56	36.77
Revenue Plane Miles Flown	37	284	412	668	619	631	1,006	1,071	1,152
International and Overseas Airlines									
Available Ton Miles Flown	425.8	480.8	540.3	554.2	608.4	693.7	760.5	856.1	983.1
Revenue Ton Miles Flown	243.7	273.5	300.4	325.4	377.8	426.3	466.8	527.4	623.6
Ton Mile Load Factor (%)	57.24	56.89	55.60	58.71	62.09	61.45	62.38	61.60	63.43
Available Seat Miles Flown	2,924.3	3,292.3	3,624.7	3,695.5	4,361.4	4,848.8	5,462.2	6,284.9	7,015.9
Revenue Passenger Miles Flown	1,810.0	1,888.9	2,054.0	2,206.4	2,599.0	3,019.8	3,381.1	3,743.3	4,410.4
Passenger Load Factor (%)	61.90	57.37	56.67	59.71	59.59	62.28	61.90	59.56	62.86
Revenue Plane Miles Flown	86.5	98.1	104.3	93.8	97.4	103.4	109.6	116.1	130.8

AVAILABLE SERVICE AND UTILIZATION *(continued)*

U. S. Scheduled Airline Industry, 1947-1955 (In Millions)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Alaskan Airlines									
Available Ton Miles Flown		20.1	20.3	19.7	15.8	26.7	34.1	34.5	45.6
Revenue Ton Miles Flown		12.8	11.1	10.1	8.5	14.4	19.5	19.4	29.0
Ton Mile Load Factor (%)	Not	63.64	54.76	50.93	54.16	53.89	57.23	56.37	63.63
Available Seat Miles Flown	Available	42.6	38.9	54.0	82.4	168.9	209.2	206.3	233.9
Revenue Passenger Miles Flown		19.6	15.4	22.4	36.5	71.2	92.4	86.9	110.4
Passenger Load Factor (%)		46.10	39.64	41.60	44.26	42.18	44.15	42.15	47.20
Revenue Plane Miles Flown		4.7	3.9	5.4	6.9	9.3	10.4	9.6	10.5
Total Scheduled Airline Industry									
Available Ton Miles Flown	1,658.7	1,899.5	2,134.6	2,331.5	2,693.7	3,230.3	3,813.5	4,336.0	5,049.8
Revenue Ton Miles Flown	942.4	1,006.8	1,140.2	1,325.4	1,629.2	1,897.3	2,178.9	2,465.0	2,907.2
Ton Mile Load Factor (%)	56.82	53.00	53.41	56.85	60.48	58.73	57.14	56.85	57.57
Available Seat Miles Flown	12,298.1	13,720.0	15,350.5	16,834.4	20,009.5	24,115.3	28,934.6	33,449.2	38,526.1
Revenue Passenger Miles Flown	7,919.5	7,871.7	8,827.4	10,241.3	13,201.6	15,618.9	18,233.8	20,652.7	24,328.0
Passenger Load Factor (%)	64.40	57.37	57.51	60.84	65.98	64.77	63.02	61.74	63.15
Revenue Plane Miles Flown	411.6	441.0	460.3	464.3	510.4	571.6	638.5	677.3	761.2

REVENUE TON-MILE TRAFFIC CARRIED

by U. S. Scheduled Airline Industry, 1947-1955 (In Thousands of Revenue Ton-Miles)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Trunk Airlines									
Passenger	579,859	558,680	632,014	747,558	982,642	1,167,556	1,377,728	1,572,594	1,855,106
Freight	35,214	70,438	94,190	112,861	100,581	117,128	131,778	144,514	173,988
U. S. Mail	32,879	37,510	40,874	46,315	62,932	68,296	71,725	80,201	85,996
Express	28,533	29,769	27,329	36,538	40,260	40,375	42,514	40,090	49,585
Charter Flights	5,774	3,158	7,483	8,203	8,576	8,593	6,874	8,317	6,928
All Other[1]	6,875	6,657	7,102	11,782	9,680	11,512	13,706	16,285	19,043
Total	689,134	706,212	808,992	963,257	1,204,671	1,413,460	1,644,325	1,862,001	2,190,646
Local Service Airlines									
Passenger	4,316	8,184	12,908	18,242	27,904	32,373	36,767	43,505	49,320
Freight	62	265	436	696	920	1,116	1,179	1,188	1,359
U. S. Mail	165	334	428	566	787	912	1,000	1,255	1,257
Express	118	190	320	623	908	894	954	1,076	1,403
Charter Flights	59	90	194	653	961	653	649	1,108	1,404
All Other[1]	18	39	60	118	132	168	198	232	245
Total	4,738	9,102	14,346	20,898	31,612	36,116	40,747	48,364	54,988

[1] All other includes excess baggage and foreign mail ton miles in international figures.

REVENUE TON-MILE TRAFFIC CARRIED *(continued)*

by U. S. Scheduled Airline Industry, 1947-1955 (In Thousands of Revenue Ton-Miles)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Territorial Airlines									
Passenger	3,839	4,309	4,309	4,680	5,234	5,354	5,806	5,947	6,600
Freight	636	581	618	529	855	1,258	1,503	1,657	1,647
U. S. Mail	43	53	70	65	59	50	57	58	59
Express	116	134	124	119	100	55	.....	.....	.....
Charter Flights	184	39	123	303	283	272	27	45	436
All Other[1]	68	68	66	55	50	49	46	36	20
Total	4,886	5,184	5,310	5,753	6,581	7,038	7,439	7,743	8,762
Helicopter Airlines									
Passenger	.....	.....	.....	.....	.....	.....	2	17	58
Freight	.....	.....	.....	.....	.....	.....	2	5	5
U. S. Mail	3	28	46	63	71	75	123	115	97
Express	.....	.....	.....	.....	.....	.....	.....	13	32
All Other[1]	.....	.....	.....	.....	.....	.....	2	2	1
Total	3	28	46	63	71	75	129	152	193
International and Overseas Airlines									
Passenger	184,303	194,399	211,734	228,114	266,989	310,716	345,383	379,801	442,880
Freight	2,110	4,012	6,714	16,050	71,004	72,346	74,427	82,101	90,710
U. S. Mail	12,756	17,203	19,772	21,188	21,875	22,068	24,466	35,321	52,409
Express	30,786	41,581	49,444	44,513	289	281	219	217	243
Charter Flights	5,275	7,990	3,233	5,730	6,724	7,846	7,700	13,790	19,701
All Other[1]	8,483	8,314	9,515	9,825	10,903	13,051	14,583	16,126	17,652
Total	243,713	273,499	300,412	325,420	377,784	426,308	466,778	527,356	623,595
Alaskan Airlines									
Passenger		1,962	1,543	2,245	3,743	7,490	9,838	9,139	11,753
Freight		1,027	618	882	1,763	4,252	5,908	5,998	7,302
U. S. Mail	Not	281	479	741	970	1,591	1,987	2,058	2,280
Charter Flights	Available	9,509	8,449	6,095	2,016	955	1,640	2,086	7,556
All Other[1]		40	27	90	51	99	114	114	150
Total		12,819	11,116	10,053	8,543	14,387	19,487	19,395	29,041
Total Scheduled Airlines Industry									
Passenger	772,317	767,534	862,508	1,000,839	1,286,512	1,523,489	1,775,524	2,011,003	2,365,717
Freight	38,022	76,323	102,576	131,018	175,123	196,100	214,797	235,463	275,011
U. S. Mail	45,846	55,409	61,669	68,938	86,694	92,992	99,358	119,008	142,098
Express	59,553	71,674	77,217	81,793	41,557	41,605	43,687	41,396	51,263
Charter Flights	11,292	20,786	19,482	20,985	18,560	18,319	16,890	25,346	36,025
All Other[1]	15,444	15,118	16,770	21,870	20,816	24,879	28,649	32,795	37,111
Total	942,474	1,006,844	1,140,222	1,325,443	1,629,262	1,897,384	2,178,905	2,465,011	2,907,225

[1] All other includes excess baggage and foreign mail ton miles in international figures.

OPERATING REVENUES

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Trunk Airlines									
Passenger	$303,194	334,736	378,113	430,098	570,288	671,257	775,782	872,834	1,021,848
Freight	$ 8,358	13,825	18,323	21,698	21,030	25,529	29,341	33,008	39,574
U. S. Mail	$ 23,326	47,838	45,031	46,311	37,040	35,910	37,083	37,310	30,136
Express	$ 10,530	9,964	8,957	12,569	14,706	15,853	16,829	15,106	19,401
Other	$ 7,082	6,990	9,359	13,433	15,457	19,466	19,758	19,956	22,330
Total	$352,490	413,353	459,783	524,109	658,521	768,015	878,793	978,214	1,133,289
Local Service Airlines									
Passenger	$2,280	4,667	7,362	10,303	16,259	19,766	23,306	27,673	32,825
Freight	$ 17	76	138	212	309	405	462	503	555
U. S. Mail	$5,920	10,911	13,533	16,400	18,850	21,177	24,356	24,652	21,809
Express	$ 43	72	114	230	357	417	463	497	664
Other	$ 151	195	271	538	966	614	771	1,148	1,288
Total	$8,411	15,921	21,418	27,683	36,741	42,379	49,358	54,473	57,141
Territorial Airlines									
Passenger	$3,102	3,888	3,794	4,105	4,639	4,433	4,771	5,268	5,686
Freight	$ 321	302	333	288	393	562	692	734	753
U. S. Mail	$ 162	189	247	285	643	768	1,128	638	339
Express	$ 108	134	145	125	119	63	....	....	....
Other	$ 208	137	259	410	418	420	135	148	336
Total	$3,901	4,650	4,778	5,213	6,212	6,246	6,726	6,788	7,114
Helicopter Airlines									
Passenger	$....	....	....	....	....	....	10	61	209
Freight	$....	....	....	....	....	....	4	14	23
U. S. Mail	$37	372	522	791	887	1,033	2,547	2,876	2,961
Express	$....	....	....	....	....	....	....	31	99
Other	$....	....	....	7	5	13	44	87	63
Total	$37	372	522	798	892	1,046	2,605	3,069	3,355
International and Overseas Airlines									
Passenger	$140,652	151,338	158,480	160,673	184,592	212,458	232,539	254,234	314,905
Freight	$ 689	1,370	2,105	5,881	25,116	26,730	27,257	29,614	31,889
U. S. Mail	$ 32,300	57,332	75,197	55,689	53,213	51,533	53,746	49,192	27,133
Express	$ 16,837	19,438	20,023	15,783	94	87	74	70	77
Other	$ 18,532	19,756	18,350	22,105	24,784	24,110	23,670	25,746	10,949
Total	$209,010	249,234	274,155	260,131	287,799	314,918	337,286	358,856	384,953

OPERATING REVENUES *(continued)*

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Alaskan Airlines									
Passenger	$	2,492	2,188	2,758	4,042	5,857	6,815	6,481	8,160
Freight	$	529	547	639	928	1,474	1,851	1,840	2,464
U. S. Mail	$	1,530	2,122	2,939	3,742	7,524	9,060	9,232	7,975
Other	$	3,798	3,639	3,102	3,430	1,106	1,574	1,653	3,794
Total	$	8,349	8,496	9,438	12,142	15,961	19,300	19,206	22,393
Total Scheduled Airline Industry									
Passenger	$449,228	497,121	549,937	607,937	779,820	913,771	1,043,223	1,166,551	1,383,633
Freight	$ 9,385	16,102	21,446	28,718	47,776	54,700	59,607	65,713	75,258
U. S. Mail	$ 61,745	118,172	136,652	122,415	114,375	117,945	127,920	123,900	90,353
Express	$ 27,518	29,608	29,239	28,707	15,276	16,420	17,366	15,704	20,241
Other	$ 25,973	30,876	31,878	39,595	45,060	45,729	45,952	48,738	38,760
Total	$573,849	691,879	769,152	827,372	1,002,307	1,148,56	1,294,068	1,420,606	1,608,245

DISTRIBUTION OF AIRCRAFT OPERATING EXPENSES

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Trunk Airlines									
Flying Operations	$ 85,933	104,164	119,961	132,060	160,469	193,384	234,928	260,233	302,526
% of Total Expenses	23.0	25.3	27.6	28.6	29.0	28.7	29.7	29.6	30.0
Direct Maint.—Flight Equip.	$ 41,029	46,093	50,270	53,747	66,571	86,452	94,816	103,104	127,418
% of Total Expenses	11.0	11.2	11.6	11.6	12.0	12.8	12.0	11.7	12.6
Depreciation—Flight Equip.	$ 36,241	39,534	39,448	39,430	41,273	57,735	79,305	94,344	90,226
% of Total Expenses	9.7	9.6	9.1	8.5	7.5	8.6	10.0	10.7	8.9
Total Aircraft Oper. Expenses	$163,203	189,791	209,679	225,237	268,313	337,571	409,049	457,681	520,170
Local Service Airlines									
Flying Operations	$2,190	4,433	6,336	8,330	10,394	13,394	15,748	17,246	18,070
% of Total Expenses	24.3	28.5	29.0	30.8	30.5	30.8	30.9	32.5	31.8
Direct Maint.—Flight Equip.	$1,332	2,289	3,198	3,433	4,284	5,451	6,479	5,950	6,709
% of Total Expenses	14.8	14.7	14.6	12.7	11.9	12.5	12.7	11.2	11.8
Depreciation—Flight Equip.	$ 908	1,375	1,938	1,492	1,613	2,443	1,893	1,818	1,818
% of Total Expenses	10.1	8.8	8.4	5.5	4.5	4.8	4.8	3.6	3.2
Total Aircraft Oper. Expenses	$4,430	8,097	11,472	13,255	16,841	20,943	24,670	25,089	26,597

DISTRIBUTION OF AIRCRAFT OPERATING EXPENSES *(continued)*

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Territorial Airlines									
Flying Operations	$ 704	946	1,091	1,221	1,468	1,623	1,875	1,908	1,942
% of Total Expenses	18.8	21.3	22.6	23.1	24.2	27.2	27.7	27.0	26.5
Direct Maint.—Flight Equip.	$ 537	603	551	543	644	580	625	712	716
% of Total Expenses	14.4	13.6	11.4	10.3	10.6	9.7	9.2	10.1	9.8
Depreciation—Flight Equip.	$ 259	330	331	359	253	143	392	482	488
% of Total Expenses	6.9	7.4	6.9	6.8	4.2	2.4	5.8	6.8	6.7
Total Aircraft Oper. Expenses	$1,500	1,879	1,973	2,123	2,365	2,346	2,892	3,102	3,146
Helicopter Airlines									
Flying Operations	$13	94	151	205	135	264	540	583	611
% of Total Expenses	25.0	27.2	29.6	28.0	18.7	25.1	22.8	22.1	20.7
Direct Maint.—Flight Equip.	$ 5	50	83	117	182	213	481	533	566
% of Total Expenses	9.6	14.5	16.3	16.0	25.2	20.3	20.3	20.2	19.2
Depreciation—Flight Equip.	$14	81	105	123	76	128	456	391	405
% of Total Expenses	26.9	23.4	20.6	16.8	10.5	12.2	19.3	14.8	13.7
Total Aircraft Oper. Expenses	$32	225	339	445	393	605	1,477	1,507	1,582
International and Overseas Airlines									
Flying Operations	$53,189	67,163	72,347	70,980	75,031	87,368	91,489	98,755	108,553
% of Total Expenses	25.4	28.5	28.6	28.6	27.8	28.7	28.8	29.7	29.7
Direct Maint.—Flight Equip.	$21,997	24,241	26,311	26,158	28,856	33,043	32,808	30,813	34,850
% of Total Expenses	10.5	10.3	10.4	10.5	11.1	10.9	10.3	9.3	9.5
Depreciation—Flight Equip.	$18,580	19,589	23,676	25,638	24,263	26,480	26,723	27,799	27,547
% of Total Expenses	8.9	8.3	9.4	10.3	9.0	8.7	8.4	8.4	7.5
Total Aircraft Oper. Expenses	$93,766	110,993	122,334	122,776	129,150	146,891	151,020	157,367	170,950
Alaskan Airlines									
Flying Operations	$	3,138	3,440	3,020	4,160	4,634	5,479	5,224	7,232
% of Total Expenses		38.9	33.8	31.1	31.6	28.4	30.0	28.9	33.0
Direct Maint.—Flight Equip.	$	923	1,342	1,591	2,257	2,744	2,673	2,581	3,288
% of Total Expenses		11.4	13.2	16.4	17.2	16.8	14.7	14.3	15.0
Depreciation—Flight Equip.	$	810	987	880	718	741	863	1,087	899
% of Total Expenses		10.0	9.7	9.1	5.5	4.5	4.7	6.0	4.1
Total Aircraft Oper. Expenses	$	4,871	5,769	5,491	7,135	8,119	9,015	8,892	11,419
Total Scheduled Airline Industry									
Flying Operations	$142,029	179,938	203,326	215,816	252,207	300,667	350,059	383,949	438,934
% of Total Expenses	23.9	26.7	28.0	28.7	28.7	28.8	29.5	29.7	30.0
Direct Maint.—Flight Equip.	$ 64,900	74,199	81,755	85,589	103,794	128,483	137,882	143,693	173,547
% of Total Expenses	10.9	11.0	11.3	11.4	11.8	12.3	11.6	11.1	11.8
Depreciation—Flight Equip.	$ 56,002	61,719	66,485	67,922	68,196	87,325	110,182	125,996	121,383
% of Total Expenses	9.4	9.1	9.2	9.0	7.8	8.4	9.3	9.7	8.3
Total Aircraft Oper. Expenses	$262,931	315,856	351,566	369,327	424,197	516,475	598,123	653,638	733,864

DISTRIBUTION OF GROUND AND INDIRECT EXPENSES

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Trunk Airlines									
Ground Operations	$ 59,464	64,915	66,623	68,541	79,265	94,606	107,044	119,207	133,231
Ground and Indirect Maintenance	$ 32,812	33,515	33,404	33,653	41,110	50,856	56,940	61,331	68,736
Passenger Service	$ 28,669	29,151	27,778	30,870	42,563	47,045	53,115	58,235	72,978
Traffic and Sales	$ 42,644	42,668	45,661	48,079	58,024	70,253	81,472	89,288	103,882
Advertising and Publicity	$ 9,486	12,343	13,533	14,566	16,211	18,880	22,027	24,861	30,809
General and Administrative	$ 31,052	31,217	30,894	33,651	40,816	46,874	52,259	57,744	68,599
Depreciation—Ground Equipment	$ 6,060	7,678	7,585	6,941	6,279	6,807	8,515	10,411	11,430
Total—Ground and Indirect Expenses	$210,187	221,487	225,478	236,301	284,268	335,321	381,372	421,077	489,665
Local Service Airlines									
Ground Operations	$1,650	2,682	3,743	4,969	6,229	7,254	8,406	8,753	9,511
Ground and Indirect Maintenance	$ 740	1,114	1,339	1,823	2,496	3,150	3,596	3,666	3,756
Passenger Service	$ 261	540	825	1,090	1,671	1,944	2,218	2,389	2,684
Traffic and Sales	$ 660	1,053	1,771	2,434	3,943	4,868	6,099	6,895	7,618
Advertising and Publicity	$ 251	386	634	807	1,072	1,172	1,340	1,449	1,656
General and Administrative	$ 902	1,436	1,792	2,367	3,247	3,682	4,028	4,330	4,476
Depreciation—Ground Equipment	$ 123	270	295	344	440	484	546	535	554
Total—Ground and Indirect Expenses	$4,587	7,481	10,399	13,834	19,098	22,554	26,233	28,017	30,255
Territorial Airlines									
Ground Operations	$ 767	904	922	906	1,040	1,002	1,212	1,268	1,258
Ground and Indirect Maintenance	$ 342	357	349	399	433	384	482	532	562
Passenger Service	$ 97	140	165	190	223	213	210	198	245
Traffic and Sales	$ 385	441	528	681	858	881	768	769	842
Advertising and Publicity	$ 50	42	100	151	172	167	143	140	204
General and Administrative	$ 502	567	682	743	887	899	953	955	963
Depreciation—Ground Equipment	$ 96	103	113	93	89	81	97	114	116
Total—Ground and Indirect Expenses	$2,239	2,554	2,859	3,163	3,702	3,627	3,865	3,976	4,190
Helicopter Airlines									
Ground Operations	$ 3	33	50	98	108	138	283	334	425
Ground and Indirect Maintenance	$ 6	39	50	66	89	124	217	275	305
Passenger Service	$....	....	....	....	....	....	11	15	22
Traffic and Sales	$....	....	....	....	....	....	26	75	141
Advertising and Publicity	$....	2	2	2	1	3	17	32	40
General and Administrative	$ 9	43	63	112	119	164	306	365	392
Depreciation—Ground Equipment	$ 2	4	6	10	11	16	30	35	45
Total—Ground and Indirect Expenses	$20	121	171	288	328	445	890	1,131	1,370
International and Overseas Airlines									
Ground Operations	$ 30,460	31,005	33,168	31,618	34,916	39,726	42,189	43,397	47,050
Ground and Indirect Maintenance	$ 17,805	20,219	20,934	17,282	20,014	21,188	22,219	22,302	24,236
Passenger Service	$ 13,084	14,034	14,617	14,589	17,511	19,554	20,027	22,372	26,716
Traffic and Sales	$ 21,996	25,350	25,560	25,886	29,821	34,945	37,727	40,573	45,872
Advertising and Publicity	$ 6,745	7,861	10,171	10,628	11,374	12,541	13,692	14,273	16,095
General and Administrative	$ 22,722	22,887	22,600	22,170	23,903	26,754	27,931	28,970	31,377
Depreciation—Ground Equipment	$ 2,716	2,938	3,479	3,374	3,041	2,668	3,102	3,434	3,526
Total—Ground and Indirect Expenses	$115,528	124,294	130,529	125,547	140,580	157,376	166,887	175,321	194,872

DISTRIBUTION OF GROUND AND INDIRECT EXPENSES *(continued)*

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Alaskan Airlines									
Ground Operations	.....	$ 845	988	966	1,411	2,182	2,449	2,612	4,224
Ground and Indirect Maintenance	.....	$ 525	1,001	774	1,429	1,923	1,919	1,997	2,010
Passenger Service	.....	$ 268	370	358	501	694	797	696	771
Traffic and Sales	.....	$ 435	598	499	699	1,170	1,364	1,384	1,321
Advertising and Publicity	.....	$ 102	116	135	175	209	297	265	275
General and Administrative	.....	$ 903	1,180	1,332	1,591	1,767	2,100	1,952	1,582
Depreciation—Ground Equipment	.....	$ 121	156	148	204	264	302	308	310
Total—Ground and Indirect Expenses	.....	$3,199	4,409	4,212	6,010	8,209	9,228	9,214	10,493
Total Scheduled Airline Industry									
Ground Operations	$ 92,344	100,384	105,494	107,098	122,969	144,908	161,583	175,571	195,699
Ground and Indirect Maintenance	$ 51,705	55,769	57,077	53,997	65,571	77,625	85,373	90,103	99,605
Passenger Service	$ 42,111	44,133	43,755	47,097	62,469	69,450	76,378	83,905	103,416
Traffic and Sales	$ 65,685	69,947	74,118	77,579	93,345	112,117	127,456	138,984	159,676
Advertising and Publicity	$ 16,532	20,736	24,556	26,289	29,005	32,972	37,516	41,020	49,079
General and Administrative	$ 55,187	57,053	57,211	60,375	70,563	80,140	87,577	94,316	107,389
Depreciation—Ground Equipment	$ 8,997	11,114	11,634	10,910	10,064	10,320	12,592	14,837	15,981
Total—Ground and Indirect Expenses	$332,561	359,136	373,845	383,345	453,986	527,532	588,475	638,736	730,845

SUMMARY OF PROFIT OR LOSS

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Trunk Airlines									
Total Operating Revenues	$352,490	413,353	459,783	524,109	658,521	768,015	878,793	978,214	1,133,289
Total Operating Expenses	$373,390	411,278	435,157	461,538	552,581	672,892	790,421	878,758	1,009,835
Net Operating Income	$(20,900)	2,075	24,626	62,571	105,940	95,123	88,372	99,456	123,454
Net Income Before Income Taxes[1]	$(26,258)	(1,413)	20,663	59,305	103,355	102,814	96,008	102,161	133,330
Income Taxes	$ (6,016)	3,583	7,285	28,426	59,858	49,280	47,624	50,671	70,229
Net Profit or Loss	$(20,242)	(4,996)	13,378	30,879	43,497	53,534	48,384	51,490	63,101
Local Service Airlines									
Total Operating Revenues	$ 8,411	15,921	21,418	27,683	36,741	42,379	49,358	54,473	57,141
Total Operating Expenses	$ 9,017	15,578	21,871	27,089	35,939	43,497	50,903	53,106	56,852
Net Operating Income	$ (606)	343	(453)	594	802	(1,118)	(1,545)	1,367	289
Net Income Before Income Taxes[1]	$(1,182)	(486)	(1,283)	(176)	601	(345)	(2,080)	1,212	65
Income Taxes	$ (77)	94	168	399	399	141	(47)	254	205
Net Profit or Loss	$(1,105)	(580)	(1,451)	(575)	202	(486)	(2,033)	958	(140)

[1] Net income before income taxes is adjusted for nonoperating items.
() Denotes red figure.

SUMMARY OF PROFIT OR LOSS *(continued)*

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Territorial Airlines									
Total Operating Revenues	$3,901	4,650	4,778	5,213	6,212	6,246	6,726	6,788	7,114
Total Operating Expenses	$3,739	4,433	4,832	5,286	6,067	5,973	6,757	7,078	7,336
Net Operating Income	$ 162	217	(54)	(73)	145	273	(31)	(290)	(222)
Net Income Before Income Taxes[1]	$ 124	167	(132)	(135)	125	254	(10)	(454)	(118)
Income Taxes	$ 35	65	57	3	77	88	(51)	(27)	8
Net Profit or Loss	$ 89	102	(189)	(138)	48	166	41	(427)	(126)
Helicopter Airlines									
Total Operating Revenues	$ 37	372	522	798	892	1,046	2,605	3,069	3,355
Total Operating Expenses	$ 52	346	510	733	721	1,050	2,367	2,638	2,952
Net Operating Income	$(15)	26	12	65	171	(4)	238	431	403
Net Income Before Income Taxes[1]	$(22)	(4)	(16)	36	138	(50)	168	353	547
Income Taxes	$	....	....	8	42	30	68	163	203
Net Profit or Loss	$(22)	(4)	(16)	28	96	(80)	100	190	344
International and Overseas Airlines									
Total Operating Revenues	$209,010	249,234	274,155	260,131	287,799	314,918	337,286	358,856	384,953
Total Operating Expenses	$209,294	235,287	252,863	248,323	269,730	304,267	317,907	332,688	365,822
Net Operating Income	$ (284)	13,947	21,292	11,808	18,069	10,651	19,379	26,168	19,130
Net Income Before Income Taxes[1]	$ (4,473)	8,780	8,816	13,631	18,801	14,380	23,393	29,723	23,481
Income Taxes	$ 651	2,415	1,362	3,623	7,063	6,651	10,865	13,047	10,314
Net Profit or Loss	$ (5,124)	6,365	7,454	10,008	11,738	7,729	12,528	16,676	13,167
Alaskan Airlines									
Total Operating Revenues	.....	$8,349	8,496	9,438	12,142	15,961	19,300	19,206	22,393
Total Operating Expenses	.....	$8,070	10,178	9,703	13,145	16,328	18,243	18,106	21,912
Net Operating Income	.....	$ 279	(1,682)	(265)	(1,003)	(367)	1,057	1,100	481
Net Income Before Income Taxes[1]	.....	$ 171	(1,817)	(396)	(1,196)	(78)	873	1,126	651
Income Taxes	.....	$ 26	15	37	24	373	113	232	367
Net Profit or Loss	.....	$ 145	(1,832)	(433)	(1,220)	(451)	760	894	284
Total Scheduled Airline Industry									
Total Operating Revenues	$573,849	691,879	769,152	827,372	1,002,307	1,148,565	1,294,068	1,420,606	1,608,245
Total Operating Expenses	$595,492	674,992	725,411	752,672	878,183	1,044,007	1,186,598	1,292,374	1,464,709
Net Operating Income	$(21,643)	16,887	43,741	74,700	124,124	104,558	107,490	128,232	143,535
Net Income Before Income Taxes[1]	$(31,811)	7,215	26,231	72,265	121,824	116,975	118,352	134,121	157,956
Income Taxes	$ (5,407)	6,183	8,887	32,496	67,463	56,563	58,572	64,340	81,326
Net Profit or Loss	$(26,404)	1,032	17,344	39,769	54,361	60,412	59,780	69,781	76,630

[1] Net income before taxes is adjusted for nonoperating items.
() Denotes red figures.

ASSETS, LIABILITIES AND CAPITAL

U. S. Scheduled Airlines, for selected years (In Thousands of Dollars)

	1948	1950	1952	1954	1955[1]
Domestic Trunk Airlines					
Assets					
Current Assets	$171,860	203,952	344,115	358,375	418,408
Flight Equipment	$299,261	274,803	576,787	782,816	868,270
— Depreciation	$110,910	173,183	258,431	394,292	458,317
Flight Equipment—Net	$188,351	201,620	309,356	388,524	409,953
Ground Property and Equipment—Net	$ 73,722	59,265	76,506	90,371	96,563
Property and Equipment—Net	$262,073	260,885	385,862	478,895	506,516
Deferred Charges	$ 16,497	16,361	8,194	9,211	10,274
Other Assets	$ 33,811	61,341	37,593	38,035	35,281
Total Assets	$484,241	542,539	775,764	884,516	970,479
Liabilities and Capital					
Current Liabilities	$ 99,837	130,107	231,760	241,942	270,746
Long Term Debt	$167,404	135,842	168,247	185,093	169,097
Operating Reserves	$ 2,387	3,971	4,169	5,796	8,531
Capital Stock	$121,313	123,469	145,135	139,360	110,017
Capital Surplus	$ 60,573	64,644	89,028	91,845	128,509
Earned Surplus	$ 13,943	67,179	133,532	207,947	246,621
Other Liabilities and Capital	$ 18,784	17,327	3,893	12,533	36,958
Total Liabilities and Capital	$484,241	542,539	775,764	884,516	970,479
Local Service Airlines					
Assets					
Current Assets	$ 5,279	7,577	10,359	11,927	11,732
Flight Equipment	$ 5,671	10,056	16,404	17,693	21,063
— Depreciation	$ 2,396	5,020	6,788	9,873	10,950
Flight Equipment—Net	$ 3,275	5,036	9,616	7,280	10,113
Ground Property and Equipment—Net	$ 2,016	1,882	3,722	2,735	3,282
Property and Equipment—Net	$ 5,291	6,918	13,338	10,555	13,395
Deferred Charges	$ 1,349	1,743	1,209	1,018	886
Other Assets	$ 819	521	917	573	848
Total Assets	$12,738	16,759	25,823	24,073	26,861
Liabilities and Capital					
Current Liabilities	$ 3,333	6,542	10,346	10,666	11,116
Long Term Debt	$ 1,590	1,485	3,575	1,931	3,650
Operating Reserves	$ 105	287	357	616	728
Capital Stock	$ 4,832	6,938	7,218	6,720	6,717
Capital Surplus	$ 4,454	4,193	5,633	4,654	4,319
Earned Surplus	$(1,665)	(2,815)	(1,821)	(556)	(91)
Other Liabilities and Capital	$ 89	129	515	42	422
Total Liabilities and Capital	$12,738	16,759	25,823	24,073	26,861
Territorial Airlines					
Assets					
Current Assets	$1,333	1,649	1,900	1,577	968
Flight Equipment	$2,411	2,300	4,338	6,354	5,824
— Depreciation	$1,261	1,653	2,277	2,899	2,908
Flight Equipment—Net	$1,150	647	2,061	3,455	2,916
Ground Property and Equipment—Net	$ 530	487	887	630	467
Property and Equipment—Net	$1,680	1,134	2,948	4,085	3,383
Deferred Charges	$ 85	72	268	161	188
Other Assets	$ 65	227	526	9	15
Total Assets	$3,163	3,082	5,642	5,832	4,554
Liabilities and Capital					
Current Liabilities	$ 486	466	1,601	1,751	1,717
Long Term Debt	$ 4	.....	1,222	1,725	1,379
Operating Reserves	$ 62	47	79	84	20
Capital Stock	$1,845	1,845	2,775	2,776	1,981
Capital Surplus	$ 372	372	372	386	832
Earned Surplus	$ 305	278	(419)	(895)	(1,378)
Other Liabilities and Capital	$ 89	74	12	5	3
Total Liabilities and Capital	$3,163	3,082	5,642	5,832	4,554

[1] Data for 1955 are as at Sept. 30th.

ASSETS, LIABILITIES AND CAPITAL *(continued)*

U. S. Scheduled Airlines, for selected years (In Thousands of Dollars)

	1948	1950	1952	1954	1955[1]
Helicopter Airlines					
Assets					
Current Assets	$ 63	302	900	2,659	2,519
Flight Equipment	$297	528	1,371	2,285	2,463
— Depreciation	$ 94	285	385	1,176	1,270
Flight Equipment—Net	$203	243	986	1,109	1,193
Ground Property and Equipment—Net	$ 10	32	105	158	223
Property and Equipment—Net	$213	275	1,091	1,267	1,416
Deferred Charges	$ 89	71	263	145	165
Other Assets	$ 1	84	113	42	23
Total Assets	$366	732	2,367	4,113	4,123
Liabilities and Capital					
Current Liabilities	$ 97	69	430	656	502
Long Term Debt	.....	.....	138	204	116
Operating Reserves	.....	.....	4	33	43
Capital Stock	$294	695	816	899	892
Capital Surplus	.....	.....	974	1,998	1,998
Earned Surplus	$(25)	(32)	5	309	551
Other Liabilities and Capital	.....	.....	.....	14	21
Total Liabilities and Capital	$366	732	2,367	4,113	4,123
International and Overseas Airlines					
Assets					
Current Assets	$ 71,748	93,957	79,437	99,695	119,706
Flight Equipment	$ 94,782	133,489	164,524	193,798	212,540
— Depreciation	$ 32,398	55,495	76,243	91,061	98,779
Flight Equipment—Net	$ 62,384	77,994	88,281	102,737	113,761
Ground Property and Equipment—Net	$ 15,030	12,231	12,775	13,380	13,659
Property and Equipment—Net	$ 77,414	90,225	101,056	116,177	127,420
Deferred Charges	$ 24,909	25,688	20,706	4,685	5,167
Other Assets	$ 30,403	9,190	16,554	21,273	27,925
Total Assets	$204,474	219,070	217,753	241,770	280,218
Liabilities and Capital					
Current Liabilities	$ 31,477	52,623	66,986	81,341	91,108
Long Term Debt	$ 5,800	41,250	27,955	29,575	45,266
Operating Reserves	$ 5,438	5,776	6,314	3,637	4,022
Capital Stock	$ 7,665	10,766	10,895	13,068	13,912
Capital Surplus	$ 30,518	62,828	62,828	62,880	63,120
Earned Surplus	$ 18,691	26,024	33,584	47,184	56,553
Other Liabilities and Capital	$104,885	19,803	9,191	4,085	6,237
Total Liabilities and Capital	$204,474	219,070	217,753	241,770	280,218
Alaskan Airlines					
Assets					
Current Assets	$3,203	2,800	4,141	4,591	6,219
Flight Equipment	$4,146	4,629	5,856	8,251	6,957
— Depreciation	$1,743	3,125	4,026	5,307	5,076
Flight Equipment—Net	$2,403	1,504	1,830	2,944	1,881
Ground Property and Equipment—Net	$1,197	1,125	2,212	2,225	2,307
Property and Equipment—Net	$3,600	2,629	4,042	5,169	4,188
Deferred Charges	$ 177	130	230	172	342
Other Assets	$ 262	281	255	347	372
Total Assets	$7,242	5,840	8,668	10,279	11,121
Liabilities and Capital					
Current Liabilities	$ 2,685	2,571	4,878	3,449	3,808
Long Term Debt	$ 408	475	1,634	1,419	1,001
Operating Reserves	$ 175	313	388	342	447
Capital Stock	$ 1,746	1,833	2,258	2,680	2,944
Capital Surplus	$ 3,256	3,248	3,121	3,800	3,578
Earned Surplus	$(1,073)	(2,626)	(3,648)	(1,593)	(832)
Other Liabilities and Capital	$ 45	26	37	182	175
Total Liabilities and Capital	$ 7,242	5,840	8,668	10,279	11,121

[1] Data for 1955 are as at Sept. 30th.

ASSETS, LIABILITIES AND CAPITAL *(continued)*

U. S. Scheduled Airlines, 1947-1955 (In Thousands of Dollars)

	1948	1950	1952	1954	1955[1]
Consolidated Industry					
Assets					
Current Assets	$253,486	310,247	440,852	478,824	559,552
Flight Equipment	$406,568	525,805	760,280	1,011,197	1,117,117
— Depreciation	$148,802	238,761	348,150	504,608	577,300
Flight Equipment—Net	$257,766	287,044	412,130	506,589	539,817
Ground Property and Equipment—Net	$ 92,505	75,022	96,207	109,499	116,501
Property and Equipment—Net	$350,271	362,066	508,337	616,088	656,318
Deferred Charges	$ 43,106	44,065	30,870	15,392	17,022
Other Assets	$ 65,361	71,644	55,958	60,279	64,464
Total Assets	$712,224	788,022	1,036,017	1,170,583	1,297,356
Liabilities and Capital					
Current Liabilities	$137,915	192,378	316,001	339,805	378,997
Long Term Debt	$175,206	179,052	202,771	219,947	220,509
Operating Reserves	$ 8,167	10,394	11,311	10,508	13,791
Capital Stock	$137,695	145,546	169,097	165,503	136,463
Capital Surplus	$ 99,173	135,285	161,956	165,563	202,356
Earned Surplus	$ 30,176	88,008	161,233	252,396	301,424
Other Liabilities and Capital	$123,892	37,359	13,648	16,867	43,816
Total Liabilities and Capital	$712,224	788,022	1,036,017	1,170,583	1,297,356

[1] Data for 1955 are as at Sept. 30th.

INTERCITY PASSENGER MILE MARKET

Common Carriers and Private Automobile, 1947-1955

(Millions of Passenger Miles)

	1947	1948	1949	1950	1951	1952	1953	1954	1955[1]
Pullman & Air Travel									
Rail Pullman	12,261	11,015	9,349	9,340	10,226	9,504	7,950	6,850	6,430
Domestic Trunk Lines	6,016	5,840	6,563	7,766	10,211	12,121	14,298	16,288	19,341
Local Service Airlines	46	88	135	189	290	340	391	407	523
Pullman and Air Combined	18,323	16,943	16,047	17,295	20,727	21,965	22,639	23,545	26,294
Airline % of Combined Total	33.08	34.99	41.74	46.00	50.66	56.73	64.88	70.91	75.55
Other Common Carriers									
Rail Coach	27,665	24,315	20,273	17,441	19,524	19,758	18,955	17,689	17,315
Intercity Motor Bus Lines	23,948	23,529	22,411	21,254	21,499	20,732	19,700	16,934	16,850
Total	51,613	47,844	42,684	38,695	41,023	40,490	38,655	34,623	34,165
Total Common Carrier	69,936	64,787	58,731	55,990	61,750	62,455	61,294	58,168	60,459
% Airline of Common Carrier	8.67	9.15	11.40	14.21	17.01	19.95	23.96	28.70	32.86
Private Intercity Automobile	272,958	287,423	316,774	337,339	379,324	410,300	432,100	549,000	575,000
Total Common and Private Carrier	342,894	352,210	375,505	393,329	441,074	472,755	493,394	607,168	635,459
Passenger Mile per Capita[2]	2,392	2,412	2,528	2,619	2,919	2,988	3,068	3,742	3,812

[1] Estimated
[2] Not in millions

REVENUE PASSENGERS CARRIED

U. S. Scheduled Airline Industry, 1947-1955 (In Thousands of Passengers)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Trunk Airlines	12,279	12,324	14,021	15,978	20,621	22,759	26,137	29,526	34,466
Local Service Airlines	236	426	678	969	1,481	1,736	2,032	2,423	2,897
Territorial Airlines	376	418	382	477	550	515	553	561	591
Helicopter Airlines							1	9	29
International and Overseas Airlines	1,360	1,373	1,520	1,675	2,033	2,362	2,682	2,888	3,376
Alaskan Airlines[1]		111	122	144	157	194	220	225	264
Total Scheduled Airline Industry	14,251	14,652	16,723	19,243	24,842	27,566	31,625	35,632	41,623

[1] Alaskan data for 1948 thru 1950 includes charter flights.

AVERAGE PASSENGER FARE

Intercity Common Carriers, 1947-1955 (In Cents Per Mile)

	1947	1948	1949	1950	1951	1952	1953	1954[1]	1955[2]
Domestic Scheduled Airlines[1]									
Coach or Tourist	.....	.....	3.96	4.10	4.45	4.18	4.13	4.34	4.36
All Services	5.06	5.76	5.76	5.55	5.60	5.55	5.43	5.37	5.34
Int'l Scheduled Airlines									
Coach or Tourist	.....	.....	.....	.....	.....	.....	5.77	5.83	n.a.
All Services	7.77	8.01	7.72	7.28	7.13	7.05	6.87	6.79	6.69
Intercity Railroads									
First Class	2.74	3.01	3.14	3.25	3.27	3.35	3.38	3.35	3.31
Coach	2.02	2.29	2.41	2.47	2.47	2.53	2.53	2.50	2.47
Intercity Motor Busses	1.70	1.74	1.84	1.88	1.94	2.02	2.05	2.07	2.06

[1] Includes trunk, local service and territorial airlines.
[2] Estimated.
n.a.—Not Available.

NEW TYPE AIRCRAFT IN SCHEDULED SERVICE

Operated as of December 31, 1955 and Cumulated Inventory, Actual and on Order through 1960 . . . U. S. Domestic and International Airlines

Aircraft Type	Number of Aircraft In Scheduled Service as of 12/31/55	Cumulative Aircraft To Be Operated		
		1956	1957	1960
B-707	0	0	0	70
CV-340	123	123	123	123
CV-440	0	18	19	19
DC-6	245	272	315	321
DC-7	92	136	207	221
DC-8	0	0	0	84
Electra	0	0	0	107
L-1049	63	81	81	81
L-1649	0	0	25	25
M-404	99	99	99	99
Viscount	6	58	60	75
Total	628	787	929	1,225

AIRCRAFT OPERATED

by U. S. Scheduled Airline Industry, as of December 31, for selected years

Aircraft Type	Number of Engines	1946		1952		1954		1955	
		Domestic[1]	Int'l[2]	Domestic[1]	Int'l[2]	Domestic[1]	Int'l[2]	Domestic[1]	Int'l[2]
Boeing									
247-D	2	4	3	.....	.....	.....	.....	.....	.....
307-B	4	5	.....	.....	.....	.....	.....	.....	.....
377	4	.....	.....	16	44	11	37	10	36
Convair									
240	2	.....	.....	99	91	92	86	93	79
340	2	.....	.....	25	.....	121	32	122	32
Douglas									
DC-3	2	470	63	381	41	299	41	302	10
DC-4	4	158	50	124	101	109	76	89	78
DC-6/6A/6B	4	.....	.....	161	124	185	179	173	226
DC-7	4	.....	.....	.....	.....	61	41	65	53
Lockheed									
Electra	2	3	.....	.....	.....	.....	.....	.....	.....
Lodestar	2	11	.....	11	.....	11	11	10	.....
Constellation	4	12	31	101	64	102	58	80	76
Super Const.	4	.....	.....	24	14	39	29	53	65
Martin									
202/202A	2	.....	.....	21	.....	25	.....	18	.....
404	2	.....	.....	96	.....	100	.....	100	.....
Vickers									
Viscount	4	.....	.....	.....	.....	.....	.....	5	.....
Total		673[3]	147	1,058	479	1,155	590	1,118	655

[1] Includes Domestic Trunk, Local Service and Territorial Airlines.

[2] Trunk Airlines who operate Domestic and International Routes usually have their aircraft certificated for both operations in order to use these aircraft interchangeably. The number of aircraft certificated for both operations and therefore, duplicated in the international figures given above are as follows: 1946—16; 1952—253; 1954—434; 1955—443.

[3] Total Domestic for 1946 includes 10 Stinson.

AIRCRAFT OPERATIONS AT CAA AIRPORT TOWERS

1947-1955 (In Thousands)

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Type of Flight Operation									
Military	1,595	2,259	2,780	2,384	2,852	2,983	3,712	4,409	4,975
Civil	13,221	12,877	10,446	9,585	9,618	7,965	7,719	8,015	8,540
Air Carrier	2,854	3,242	3,713	4,002	4,556	4,866	5,384	5,521	5,983
Total	17,670	18,378	16,939	15,971	17,026	15,814	16,815	17,945	19,480
% Air Carrier of Total	16.2	17.6	21.9	25.1	26.8	30.8	32.0	30.8	30.7

NOTES: Air Carriers include scheduled and non scheduled operations.
Each landing is counted as an operation as is also each take off.

COMPARATIVE TRANSPORTATION SAFETY RECORD

Passenger Fatality Rate Per 100,000,000 Passenger Miles, 1947-1955

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Domestic Scheduled Airlines [1]									
Fatalities	199	83	93	96	142	46	86	16	156
Rate	3.2	1.3	1.3	1.1	1.3	0.4	0.6	0.09	0.78
International Scheduled Airlines									
Fatalities	20	20	0	48	31	94	2	0	2
Rate	1.1	1.0	....	2.1	1.1	3.0	0.1	....	0.04
Motor Buses									
Fatalities	140	120	120	100	130	100	70	60	n.a.
Rate	.21	.18	.20	.17	.22	.16	.13	.11	n.a.
Railroad Passenger Trains									
Fatalities	75	52	29	184	150	14	50	23	16 p
Rate	.16	.13	.08	.58	.43	.04	.16	.08	.06 p
Passenger Autos and Taxis									
Fatalities	15,300	15,200	15,300	17,600	21,000	22,600	23,500	22,500	n.a.
Rate	2.3	2.1	2.0	2.2	2.4	2.8	2.9	2.6	n.a.

[1] Includes domestic trunk, local service and territorial airlines.
n.a.—Not Available.
p. —Preliminary

CLASSES OF UNITED STATES COMMERCIAL AIR CARRIERS

At the present time there are seven recognized classes of air carriers in the air transport industry of the United States. This classification is used by the Civil Aeronautics Board in connection with the economic regulation of the industry under the Civil Aeronautics Act is based largely on the scope of operations authorized or allowed by that Act. Classes One to Six have certificates of convenience and necessity and conduct regularly scheduled services.

1. The Domestic Trunk Lines include those air carriers which presently have permanent operating rights within the continental United States. These rights derive largely from operations by present or predecessor companies antedating the Civil Aeronautics Act of 1938 which granted them "grandfather rights." There are currently twelve trunk lines, most of which operate high-density traffic routes between the principal traffic centers of the United States.

American	Continental	National	Trans World
Braniff	Delta-C&S	Northeast	United
Capital	Eastern	Northwest	Western
Colonial			

2. The Domestic Local Service Lines have, with one exception, been certificated since 1945. These carriers operate routes of lesser traffic density between the smaller traffic centers and between these centers and principal centers. The fourteen local service lines in 1955 were:

Allegheny	Frontier	Ozark	Southwest
Bonanza	Lake Central	Piedmont	Trans Texas
Braniff	Mohawk	Southern	West Coast
Central	North Central		

3. The International and Overseas Lines include all U. S. flag air carriers operating between the United States and foreign countries other than Canada. Some of these carriers conduct operations between foreign countries and some are extensions of domestic trunk lines into Mexico and the Caribbean.

American	Eastern	Pacific Northern	South Pacific[2]
Braniff	Mackey[2]	Pan American	Trans World
Caribbean Atlantic	Midet[2]	Pan American-Grace	U. M. C. A.[2]
Colonial	National	Resort[1]	United
Delta-C&S	Northwest	Samoan[2]	

4. The Territorial Lines include two groups of carriers. The Insular Lines operate in the U. S. Island possessions in the Pacific and the Caribbean and the Alaskan Lines operate between the U. S. and Alaska and within Alaska.

Insular Lines	*Alaskan Lines*			
	Operating between the U. S. and Alaska		Operators within Alaska	
Hawaiian	Alaska	Pacific Northern	Alaska	Howard J. Mays
Trans-Pacific	Northwest	Pan American	Alaska Coastal	Northern Consolidated
			Bristol Bay	Pacific Northern
			Byers	Pan American
			Cordova	Reeve Aleutian
			Ellis	Wien

5. The Helicopter Airmail Lines presently operate between airports, central post offices, and suburbs in New York, Chicago and Los Angeles. Originally certificated as exclusive mail carriers, some of them now fly passengers, air freight and air express. These carriers hold temporary certificates and are considered to be experimental in nature.

Helicopter Air Service	Los Angeles Airways	New York Airways

6. The All Cargo Lines operate under special temporary certificates authorizing scheduled cargo flights between designated areas in the U. S., and in one case to the Caribbean and in another to Europe. These carriers cannot carry either air mail or passengers.

Aerovias Sud Americana	Riddle	Slick
Flying Tigers	Seaboard & Western	

7. Non-certificated Air Carriers include a diversified group of operators who, with the exception of the air taxi operators and air freight forwarders, are not authorized to engage in regularly scheduled service. They are described in the CAB 1954 Annual Report as follows:

Operators of various types of air services have been authorized by the Board through the exemption process, rather than through the requirement that a certificate of convenience and necessity be obtained. At present this group includes:

Large irregulars and irregular transport carriers	53
Air Taxi operators (includes 50 Alaskan)	1,589
Alaska pilot-owners	153
Air freight forwarders	62

[1] Certificated cruise carrier.

[2] Certificated non-mail carriers. Statistical data of these carriers are not included in the following statistical tables.

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***Caribbean Atl. Airlines, Inc.,** *Dionisio Trigo, Pres., P. O. Box 6035, Loiza Street Station, Santurce, Puerto Rico*
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Colonial Airlines, Inc., *Branch T. Dykes, Pres., 230 Park Avenue, New York 17, New York*
Continental Air Lines, Inc., *Robert F. Six, Pres., Stapleton Airfield, Denver 7, Colorado*
Cordova Airlines, *Merle K. Smith, President & General Mgr., P. O. Box 1499, Anchorage, Alaska*
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Pan American World Airways, Inc., *J. T. Trippe, Pres., 135 E. 42nd Street, New York 17, New York*
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***Slick Airways, Inc.,** *D. W. Rentzel, Chairman of the Board, 3000 N. Clybourn Avenue, Burbank, California*
Southern Airways, Inc., *Frank W. Hulse, Pres., 1140 Brown Marx Building, Birmingham, Alabama*
Southwest Airways Co., *John H. Connelly, Pres., San Francisco Intl. Airport, San Francisco, California*
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***Trans-Canada Air Lines,** *W. Gordon Wood, Vice President-Traffic, Room 442, International Aviation Bldg., 1080 University Street, Montreal 3, Que., Canada*
Trans-Texas Airways, *R. E. McKaughan, Pres., 1221 Commerce Bldg., Houston 2, Texas*
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United Air Lines, *W. A. Patterson, Pres., 5959 S. Cicero Avenue, Chicago 38, Illinois*
West Coast Airlines, Inc., *Nick Bez, Pres., Boeing Field, Seattle 8, Washington*
Western Air Lines, Inc., *T. C. Drinkwater, Pres., 6060 Avion Drive, Los Angeles 45, California*
Wien Alaska Airlines, *Sigurd Wien, President & General Manager, Box 649, Fairbanks, Alaska*

*Associate Members

17TH EDITION

Air Transport Facts and Figures, 1956

AIR TRANSPORT ASSOCIATION OF AMERICA
1107 SIXTEENTH ST. N.W., WASHINGTON, D. C.

Federal Offers Light, $2,000 Autopilot

New York—Deliveries of a $2,000-class of lightweight tubeless autopilots specifically designed for light and medium-size business aircraft have been started by Federal Telephone & Radio Corp., Clifton, N. J. Federal spokesmen say that the company will produce approximately 1,000 of the new units this year.

Two versions of the autopilot are being produced:

- **Model F200,** a two-axis unit for aircraft with coordinated ailerons and rudder. Weighing 17 lb. uninstalled, it lists for $1,995.
- **Model F300,** a 3-axis version for aircraft with uncoordinated ailerons and rudder and for the light twin class up through the Aero Commander, weighs 19 lb. uninstalled and lists for $2,325.

Weight of either model installed is less than 25 lb. The units are marketed in kit form with all wiring, control cables, pulley brackets and other installation items pre-cut.

Certificated

The new Federal autopilots are now certificated by Civil Aeronautics Administration for all models of the Beech Bonanza; FTR is running a series of certification trials on other aircraft models and expects to complete the required tests by the end of June. John Brophy, Federal T&R aviation sales manager, plans to make a nationwide demonstration tour of the autopilot in a 1955 Cessna 310 in the next few weeks, visiting major business aircraft manufacturers. Sales are being handled through the company's distributorship organization (AW Jan. 23, p. 67).

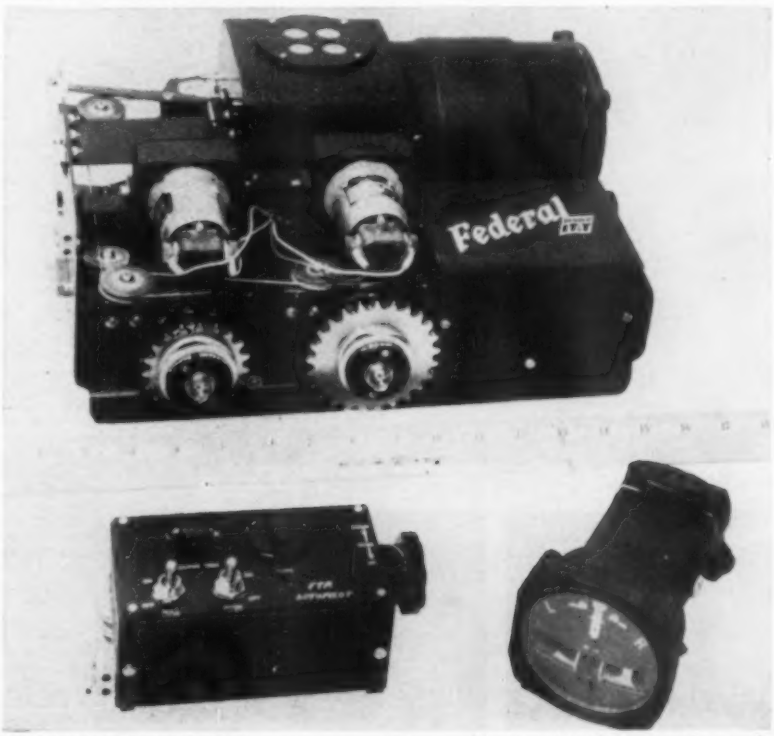
The Federal autopilots are developments of units initially designed by Ansco Division of General Aniline & Film Corp., which were acquired by FTR as part of a diversification plan whereby the company has entered the commercial aviation field. In addition to the autopilot it is developing a lightweight civil Tacan and other navigation and communications equipment for business aircraft.

Further development being done on the autopilot for the future includes tubeless altitude hold control, approach control and automatic trim control.

Basic Design

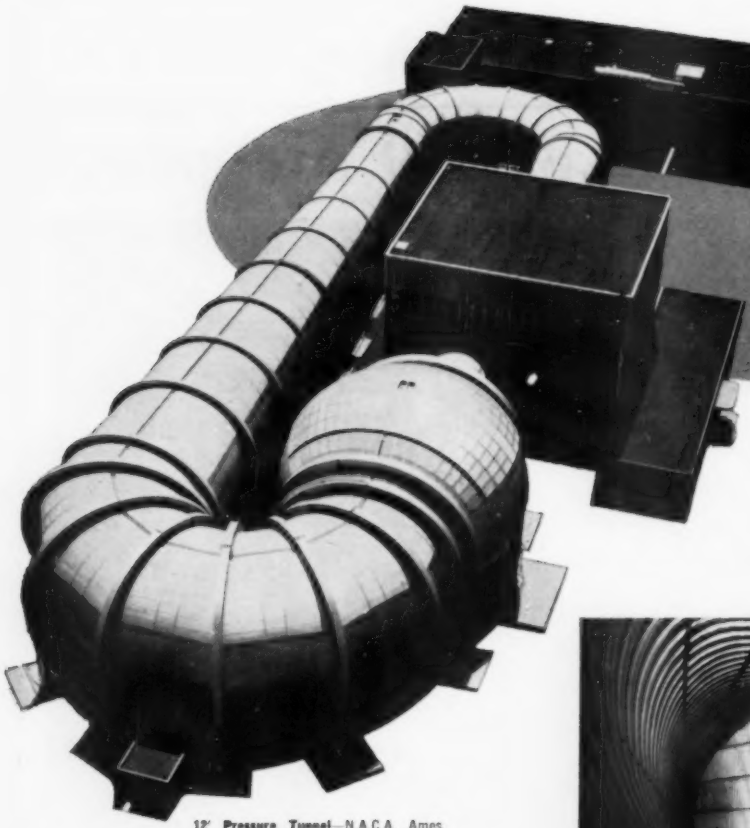
Both the F200 and F300 basically consist of a gyro servo assembly, a control panel and a turn-and-bank indicator. Relay-controlled servo mechanisms actuate the airplane's control surfaces

AUTOPILOT CONTROL UNIT is mounted below engine controls in Cessna 310 cockpit.

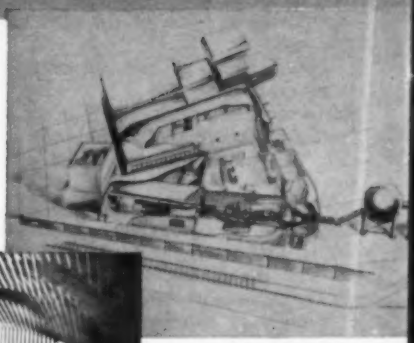


AUTOPILOT COMPONENTS: gyro servo (top), turn-and-bank unit (right), manual controls.

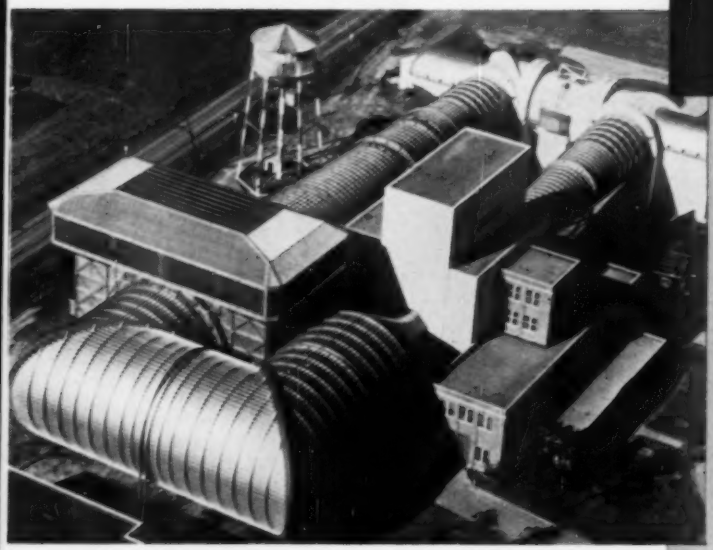
PITTSBURGH Wind



12' Pressure Tunnel—N.A.C.A. Ames Laboratory, Moffett Field, Calif.

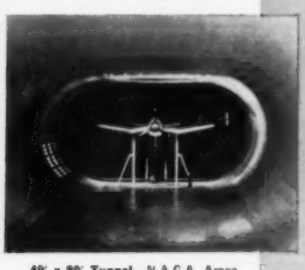


4' x 4' Supersonic Blowdown Tunnel—Under construction for Boeing Airplane Company, Seattle, Wash.



Remodeled 16' Tunnel—N.A.C.A. Langley Aeronautical Laboratory, Langley Field, Va.

16' x 16' Transonic Tunnel—Arnold Engineering Development Center, Tullahoma, Tenn.



40' x 80' Tunnel—N.A.C.A. Ames Laboratory, Moffett Field, Calif.

THE ROLL CALL

Tunnels by PDM

U. S. AIR FORCE
16' x 16' Transonic Tunnel
Arnold Engineering Development Center
Tullahoma, Tennessee

U. S. AIR FORCE
16' x 16' Supersonic Tunnel
Arnold Engineering Development Center
Tullahoma, Tennessee

U. S. AIR FORCE
By-Pass Shell for Compressor, 16' x 16' Supersonic Tunnel
Arnold Engineering Development Center
Tullahoma, Tennessee

U. S. AIR FORCE
Intermittent Air Heater for Ram Jet Addition
Arnold Engineering Center
Tullahoma, Tennessee

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Two Continuous Air Heaters
Wright-Patterson AF Base

U. S. AIR FORCE
5' Propeller Hub Altitude Test Facility
Wright-Patterson AF Base

U. S. AIR FORCE
Nozzle for Supersonic Tunnel
Wright-Patterson AF Base

U. S. AIR FORCE
Transonic Test Section for 10' Tunnel
Wright-Patterson AF Base

U. S. ARMY (Ordnance)
Two Supersonic Tunnels
Aberdeen Proving Ground, Md.

U. S. ARMY (Ordnance)
Sonic Wind Tunnel
Picatinny Arsenal, N. J.

N.A.C.A.
Free Flight Apparatus
Langley Aeronautical Laboratory
Wallops Island, Va.

N.A.C.A.
40' x 80' Tunnel
Ames Laboratory
Moffett Field, Calif.

N.A.C.A.
12' Pressure Tunnel
Ames Laboratory
Moffett Field, Calif.

N.A.C.A.
1' x 3' Supersonic Tunnels
Ames Laboratory
Moffett Field, Calif.

N.A.C.A.
1' x 3' Atmospheric Tunnel
Ames Laboratory
Moffett Field, Calif.

N.A.C.A.
6' x 6' Supersonic Tunnel
Ames Laboratory
Moffett Field, Calif.

N.A.C.A.
Rebuilding 16' Tunnel
Ames Laboratory
Moffett Field, Calif.

N.A.C.A.
20' Low Pressure Low Temperature Tunnel
Lewis Flight Propulsion Lab.
Cleveland, Ohio

N.A.C.A.
7' x 10' Icing Research Tunnel
Lewis Flight Propulsion Lab.
Cleveland, Ohio

N.A.C.A.
8' Supersonic Tunnel
Lewis Flight Propulsion Lab.
Cleveland, Ohio

N.A.C.A.
Unitary Plan Tunnel
Lewis Flight Propulsion Lab.
Cleveland, Ohio

N.A.C.A.
19' Pressure Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

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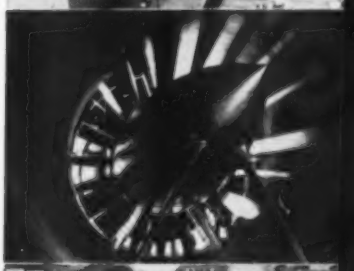
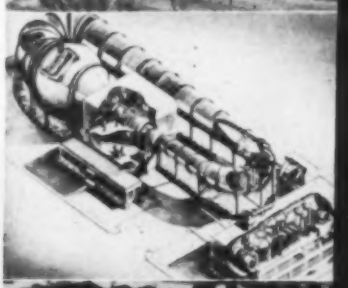




N.A.C.A.
Two Dimensional Pressure Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
16' Atmospheric Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
7' x 10' Low Speed Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
7' x 10' High Speed Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
Flutter Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
Rebuilding 16' Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
Modification of 7' x 10' H.S. Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
Air Storage System for Blow-Down Facility
Langley Aeronautical Lab.
Langley Field, Va.

N.A.C.A.
Conversion of 19' Pressure Tunnel
Langley Aeronautical Lab.
Langley Field, Va.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
10' Pressure Tunnel
Cambridge, Mass.

CORNELL LABORATORY
12' Pressure Tunnel
Buffalo, N. Y.

BOEING AIRPLANE CO.
4' x 4' Supersonic Blow-Down Tunnel
Seattle, Washington

McDONNELL AIRCRAFT COMPANY
7' x 10' Low Speed Tunnel
St. Louis, Mo.

NORTH AMERICAN AVIATION INC.
7' x 7' Trisonic Blow-Down Tunnel
El Segundo, Calif.

PRATT & WHITNEY AIRCRAFT
18' Engine Testing Tunnel
E. Hartford, Conn.

PRATT & WHITNEY AIRCRAFT
Blow-Down Facility
E. Hartford, Conn.

U. S. NAVY
3—9' x 10' Atmospheric Tunnels
David W. Taylor Model Basin
Carderock, Md.

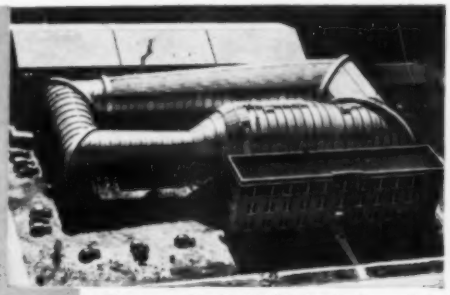
U. S. NAVY
Water Tunnel
Carderock, Md.

U. S. NAVY
Supersonic Tunnel and Burner Tunnels
Daingerfield, Texas

U. S. NAVY
Water Tunnel
Penns. State University
University Park, Pa.

U. S. NAVY
32'5" Diam. Vacuum Sphere for Supersonic Tunnels
David W. Taylor Model Basin
Carderock, Md.

U. S. NAVY
Blow-Down Facility
Daingerfield, Texas



19' Pressure Tunnel—N.A.C.A. Langley Aeronautical Laboratory, Langley Field, Va.

8' x 6' Supersonic Tunnel—N.A.C.A. Ames Laboratory, Moffett Field, Calif.

16' Atmospheric Tunnel—N.A.C.A. Langley Aeronautical Laboratory, Langley Field, Va.

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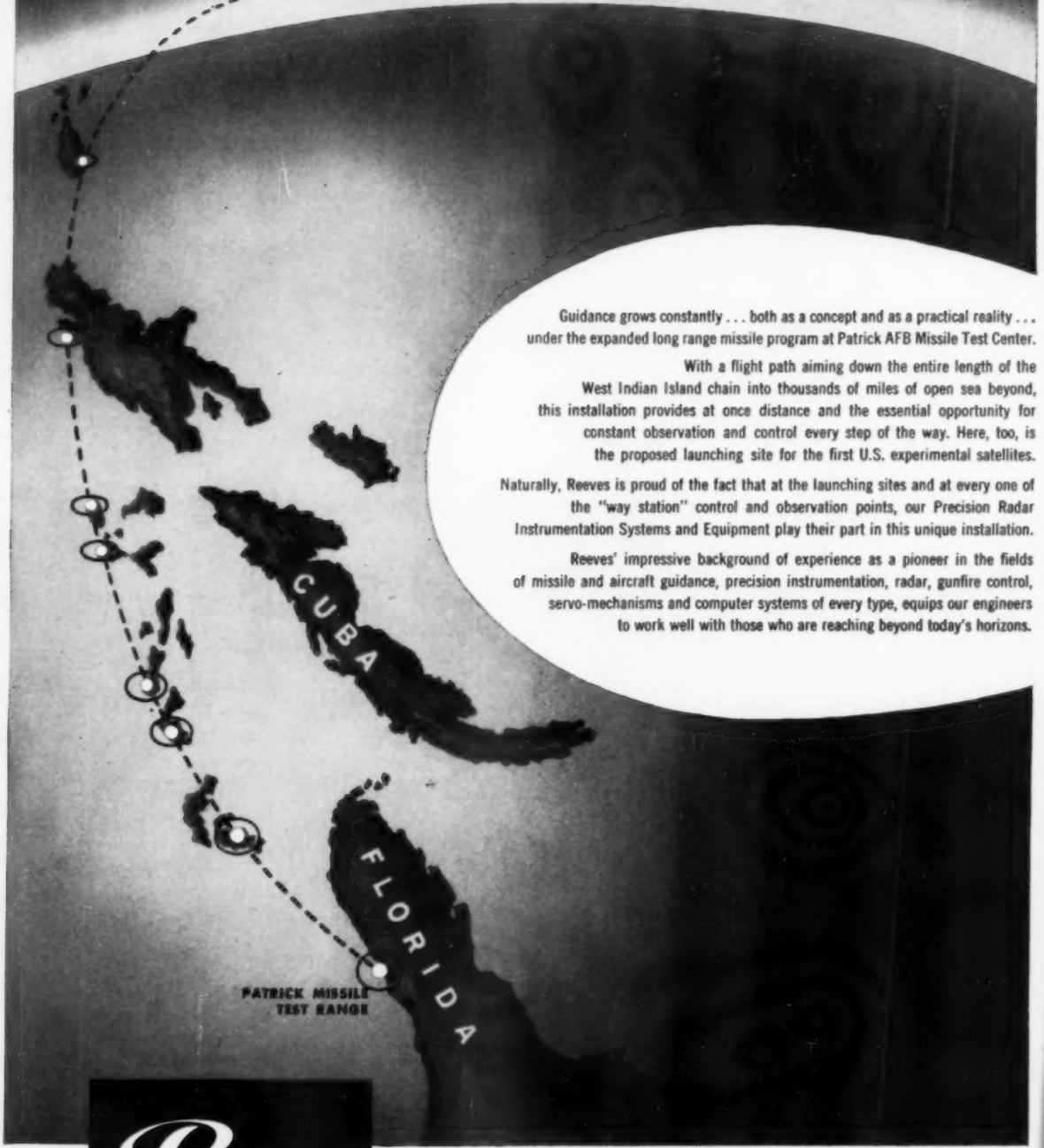

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With a flight path aiming down the entire length of the West Indian Island chain into thousands of miles of open sea beyond, this installation provides at once distance and the essential opportunity for constant observation and control every step of the way. Here, too, is the proposed launching site for the first U.S. experimental satellites.

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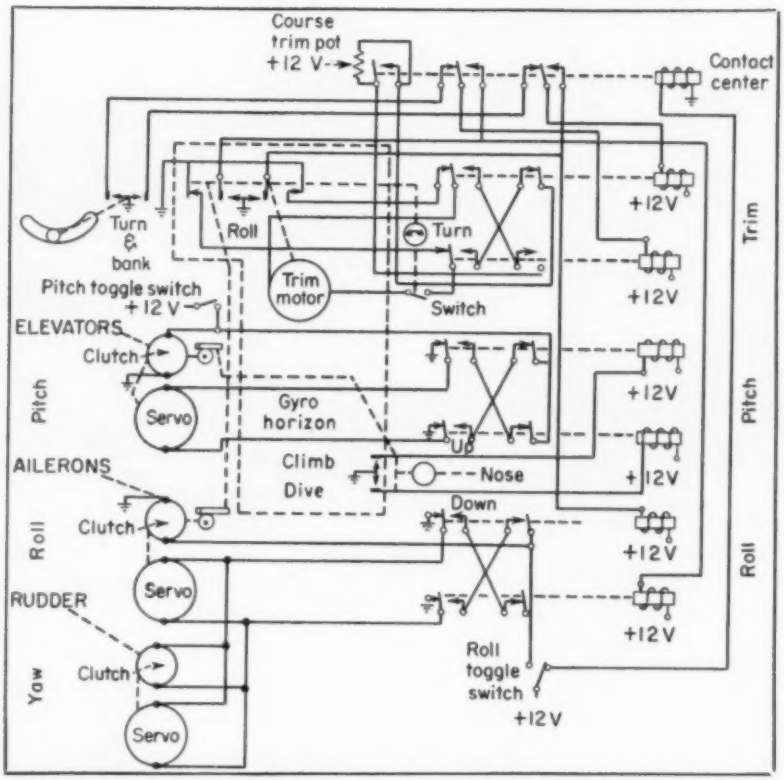

THREE-AXIS F300 autopilot schematic; the two-axis F200 is similar except that the yaw servo and clutch are omitted. Use of many off-the-shelf units eases maintenance.

to maintain the desired altitude. Both units have roll-and-pitch axis; the F300 incorporates an additional yaw axis.

The turn-and-bank unit and roll-and-pitch units of the gyro-horizon assembly contain a set of electrical pickoffs. In normal flight the pickoffs are centered and null. Rough air or movement of the autopilot control knobs, cause appropriate pickoffs to move off center and operate one of the relays. The relay then applies current to the servo system to drive the appropriate control surfaces until the ordered flight attitude is reached; then the pickoffs center and are null until the controls are again moved or the aircraft is displaced from the desired attitude.

Low Power

The autopilots operate from either a 12-v. or 24-v. input and there is no effective power consumption when the system is at null. Heart of the unit, the gyro-servo assembly, is usually installed in the fuselage aft of the cabin. It measures 15-in. long x 11¼-in. wide x 16¼-in. high. The control "black box," mounts onto the panel of small aircraft or on the control pedestal of larger types and is only 4-in. x 3¼-in. x 3¾-in. Its manual controls include "turn," "pitch," "course trim" and two on-off "roll" and "pitch" toggle switches. Control of roll and pitch stabilization can be made together or individually. The turn-and-bank indicator sensing unit is also used as a standard visual flight instrument. It measures 3 in. x 3-in. x 6 9/16-in.

Control Functions

The knobs on the control box give the pilot right and left autopilot command through 30 deg. either side; 10 deg. nose-up and nose-down. On early models the right-and-left control was graduated in five-degree increments using detents; however production models have eliminated the detents so that the pilot can adjust for any variation of degree within the 30-deg. limits.

The roll trim control can be adjusted to 5-7 deg. either left or right.

Safetywise, hardovers are virtually eliminated, the company emphasizes. The system is mechanically set so that if there were any malfunction of the roll control, the most the airplane would go over would be 30 deg.; in pitch, the plane would automatically nose up to a maximum of 10 deg., depending on its speed.

Helio Delivers Faster Courier Business Plane

Initial deliveries have been made by Helio Aircraft Corp. of the 1956 Courier business plane.

The plane has a 167-mph. cruising speed at 70% power at 8,500 ft., a 10-mph. increase over last year's model. At the optimum cruise speed of 157 mph. at 60% power, the Courier has a 745-mi. range with 45 min. reserve.

Major changes over the 1955 airplane are a redesigned windshield and other aerodynamic improvements in addition to a quieter cabin. Helio is offering as optional equipment a new muffler system for the Lycoming engine exhaust augmentor. The plane has been flown with the Lear Arcon rudder control.

Since setting up its Courier production line last August, Helio has delivered 28 four-place Couriers. All of them have incorporated Goodyear's crosswind landing gear.

Powered by 260-hp. Lycoming, the all-metal Courier is designed to fly at less than 30 mph. and is guaranteed by the manufacturer to take off and land in less than 75 yards fully loaded.

The airplane is certificated for skis and is now in the process of getting approval for floats.

First Aero Commander 680 Delivered

First Aero Super Commander 680 executive transport, powered by supercharged 340-hp. Lycomings, has been delivered to Long Manufacturing Co., Tarboro, N. C. The firm makes tobacco harvesters and hay balers. The new Aero Commander has a top speed of 260 mph.

Skyways WITHOUT Runways

A small clearing in the jungle . . . an ice floe in the arctic . . . a mountain plateau—a cruiser deck, a rooftop—these are some of the airbases of Vertol aircraft.

Free from the restricting dimensions of distant airfields and costly runways, Vertol helicopters have led the way in developing a new kind of mobility. Their tandem rotor performance has withstood the test of Army field service, Naval duty and of global Air Force missions ranging from arctic tundra to equatorial forests.

Revolutionary aircraft now taking shape at Vertol will combine helicopter ability to hover, to rise and land vertically, with the performance of current jets. Now, at Vertol, the Skyways-without-Runways concept is being taken to its ultimate phase: high speed aircraft capable of vertical takeoff and landing.

Engineers, join Vertol's advanced engineering team!

VERTOL *Aircraft Corporation*

MORTON, PENNSYLVANIA

FORMERLY PIASECKI HELICOPTER CORPORATION

PRIVATE LINES

Cessna has completed mating components of its Model 620 four-engine pressurized executive transport at Wichita, Kans. (AW April 2, p. 66).

Big Three business plane manufacturers, Beech, Cessna and Piper shipped a total of 575 civil aircraft in March; bringing their 1956 first quarter total to 1,632 airplanes. Respective figures for these periods last year were 435 and 1,072.

A 17-year-old pilot has been awarded an instrument rating. Gary Wright, East Point, Ga., soloed on his 16th birthday, now hopes to get his commercial rating on his 18th birthday. He flies a Luscombe.

Six Beech D50 Twin-Bonanza business transports have been purchased off-the-shelf for immediate delivery by the U. S. Army for field command use. Order is valued at about $500,000.

Bensen Aircraft Corp., Raleigh, N. C., has named Frank Ogden, Toronto, Ont., as Canadian distributor for its small powered and non-powered helicopter-type gliders.

Index to bulletins on accident prevention, pilots safety information exchange and business pilots safety data published during 1955 by Flight Safety Foundation is now available. Write the Foundation at 468 Fourth Ave., New York 16, N. Y.

Taylorcraft, Inc., has shipped two Fiberglas plastic-covered Ranch Wagon utility planes to Argentina. The aircraft, with spares, are valued at over $50,000. Order was placed by Sociedad Anonima Commercial E. Industrial, Buenos Aires.

Aircraft sales of $700,000 were recorded by dealers at Vancouver (B.C.) International Airport during 1955. Cessna and Piper dealers at the field sold 70 aircraft. Including sales closed at the factories, more than $1 million worth of new aircraft entered the province last year.

Piper Apache backlog now runs into October. Company recently delivered Apache No. 500 to Able Supply Co., Houston, Tex. . . . Three Apaches have been placed into operation as executive transports by North American Aviation, Inc., Los Angeles.

East Coast Aviation Corp., Bedford Airport, Lexington, Mass., has been retained by Radio Corporation of America and Laboratory for Electronics, under

Here, at last is a mask hose connector that automatically closes when disconnected, causing a noticeable increase in breathing resistance. This increased breathing effort serves as an immediate warning signal to the wearer of the oxygen mask that he has become disconnected from his oxygen supply. The MC-3 connector incorporates the standard fitting for attaching the oxygen bail-out bottle. It is also interchangeable with present disconnects. You're safe with the Scott MC-3 connector!

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As a crew chief, the one must keep his aircraft functioning like a thoroughbred . . . utilizing his training and that inbred American capacity for competence when working with tools.
The pilot, a seasoned officer, typifies Air Force career men who've flown Thunder-craft, proving what men and planes can do when the chips are down.
It's a matter of record with thousands of pilots, and those who keep 'em flying . . . Republic Thunder-craft have established a reputation as the fastest, hardest hitting, longest range, most rugged jet planes in the fighter-bomber field.
Latest . . . in this renowned family of fighter fame is the F-84F Thunderstreak . . . atomic-bomb-carrying jet-fighter-bomber, and its photo reconnaissance counterpart the RF-84F Thunderflash.
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contracts from USAF, to maintain Air Force planes used by the firms in development and flight testing weapons and navigation systems. East Coast Aviation is spending a quarter of a million dollars in expanding its maintenance and service activities.

Facilities expansion to permit servicing of aircraft up to DC-7 size is underway by Newark Air Service, Newark Airport, N. J. Expansion, to be completed by October, is designed to cope with reported increase in business airplane activities.

Movie illustrating 180-deg. turn procedure designed to allow inexperienced pilots to fly out of bad weather has gone into production at University of Illinois Institute of Aviation, Urbana, Ill., where the procedure was developed. The 16-mm. sound and color film is being made under auspices of Aircraft Owners & Pilots Assn., and showings are planned throughout the U.S.

Kindred Aviation Co., Burbank, Calif., has purchased Aircraft Engine Supply Co., same city, for over a half-million dollars.

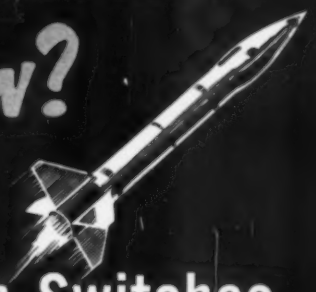
New performance figures for the Edgar Percival P.9 agricultural airplane (AW Feb. 13, p. 93) show gains over earlier data. Performance at gross weight at sea level: top speed (takeoff power), 146 mph.; top speed (maximum continuous power), 142 mph.; cruise speed, 128 mph.; most economical cruise speed, 120 mph.; rate of climb, 1,140 fpm.; takeoff distance with 5-mph. wind, 105 yd. and landing speed, lightly loaded, 37 mph.

Lodestar with tricycle landing gear is being developed by a U.S. business transport conversion center. Prototype installation is expected to fly before the end of this year. Firm reports that retrofit installations will be possible for current Lodestar owners.

Aircraft brokerage department, specializing in multi-engine corporate planes, has been opened by Southern Airways Co., Atlanta, Ga. It is in charge of Thomas R. Foster.

First National Convention of Flying Clubs will be held July 30-Aug. 2 in Seattle, Wash. It is estimated that members from over 1,000 U. S., Canadian and Mexican flying clubs will participate and over 600 private planes will be flown in. Convention will include a trip to Boeing Airplane Co.'s Seattle plant to view the 707 prototype jet tar.'_r-transport. Host will be the Washington State Aviation Assn. For details, write: Stuart Nicholson, 1466 Dexter Horton Building, Seattle, Wash.

What's New?



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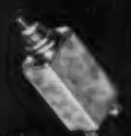

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CAB Report on Currey DC-3 Crash at Burbank

Pilot Made Faulty One-Engined Approach

Currey Air Transport's Flight 24 of September 8, 1955, a DC-3C, N 74663, struck powerlines during an attempt to make an emergency landing and crashed at the Lockheed Air Terminal, Burbank, California, about 0757.[1]

Both captain and co-pilot were killed, the stewardess and one passenger were seriously injured, and the remaining 29 passengers received minor injuries. One person on the ground was fatally injured; the aircraft was almost totally destroyed by impact.

This was a nonscheduled flight originating at Burbank, California, for Oakland, California. There were 30 passengers and a crew consisting of Captain Joseph A. Bradsher, Co-pilot Keith C. Dutson, and Stewardess Utta Jorgensen. Company records indicated that takeoff gross weight was 26,089 pounds (authorized maximum was 26,200 pounds), and the center of gravity of the aircraft was located within prescribed limits.

A Defense Visual Flight Rules flight plan was filed; the plane was loaded, taxied to the end of the runway, and its engines were run up. At 0751 the flight was cleared for takeoff from runway 15, to climb westward on top of haze and smoke. It executed a takeoff and climbed in a normal manner into smoke haze, which was more dense toward the south, and in which it was lost to view of observers at the airport.

Emergency Declared

Approximately one minute[2] after takeoff (0752) Flight 24 called the tower and requested an emergency landing clearance. This was granted; runway 7 was suggested by the tower and accepted by the pilot. The airport was cleared of traffic and emergency equipment alerted. At 0755 the tower called repeatedly as the flight had not been sighted. At 0756 the flight called the tower and stated its intent to land on runway "31." Lockheed Air Terminal has no runway 31 but has a runway 33.

About this time Flight 24 was sighted by the control tower operator an estimated one mile to the southwest, proceeding in a nose-high altitude toward the airport but not aligned with any runway. Across the approach track being used was a powerline about 500 feet short of the airport boundary.

As this line was approached the nose-high altitude increased and immediately after passing this powerline the aircraft executed a slight left turn, banked 10 to 12 degrees. The left wing then struck a service powerline at the airport boundary. The aircraft stalled, its left wing collided with two parked Air Force C-54s, it cartwheeled, slid across the apron and struck Lockheed Service Hangar No. 24, coming to rest in the open doorway of that hangar. The fuselage broke open at a point behind the wing and most of the survivors escaped or were rescued through this opening.

Small fires started by the crash were quickly extinguished by personnel of Lockheed's plant protection organization, who also rescued survivors and rendered first aid most efficiently. This organization also guarded the scene and wreckage.

INVESTIGATION

Examination of the wreckage disclosed extensive damage to all major assemblies of the airframe. All was due to impact with the two other aircraft, the ground, and the hangar. The landing gear was found to be down and locked and the flaps were retracted.

All electrically operated powerplant shutoff valves to the two engines were examined carefully. They were positioned as follows: Right powerplant—oil and hydraulic, both fully closed; left powerplant, oil one-half closed, hydraulic two-thirds closed. Fuel crossfeed valves were closed, the right engine fuel valve was in the left main tank position, and the left engine fuel valve was in the right main tank position.

Complete teardown examination of both engines disclosed that: the left engine, except for impact damage, was capable of delivering its power in a normal manner. The right engine had sustained internal damage during operation; a small amount of bearing metal was present in the main oil sump. The front master rod bearing had overheated but there was no appreciable loss of its bearing metal; it had lost about 50 percent of its lead-indium coating but none of its silverplating.

The rear master rod had been discolored by heat; the lead-indium coating of its bearing had been worn away and about 40 percent of the silverplating had been worn from the shell of its upper half. The silverplating of the lower half of this bearing was badly scored. There was no other significant damage found. The right propeller governor and all the oil passages serving it were free from foreign material and were capable of normal operation.

The blades of the left propeller were at 32 degrees when impact occurred; those of the right propeller were at 18 degrees.

Feathering Circuits

Examination of the feathering circuits of the right propeller disclosed an intermittent open circuit in the wire connecting the feathering button holding coil and the feathering pump relay. The cause of the open circuit was a loose soldered connection on the holding coil terminal. This condition could have been produced by im-

[1] All times herein are Pacific Standard and are based on the 24-hour clock.

[2] The time interval may have been anywhere from one minute to one minute and 59 seconds as the clock used indicates only full minutes. This applies to all radio communications mentioned herein.

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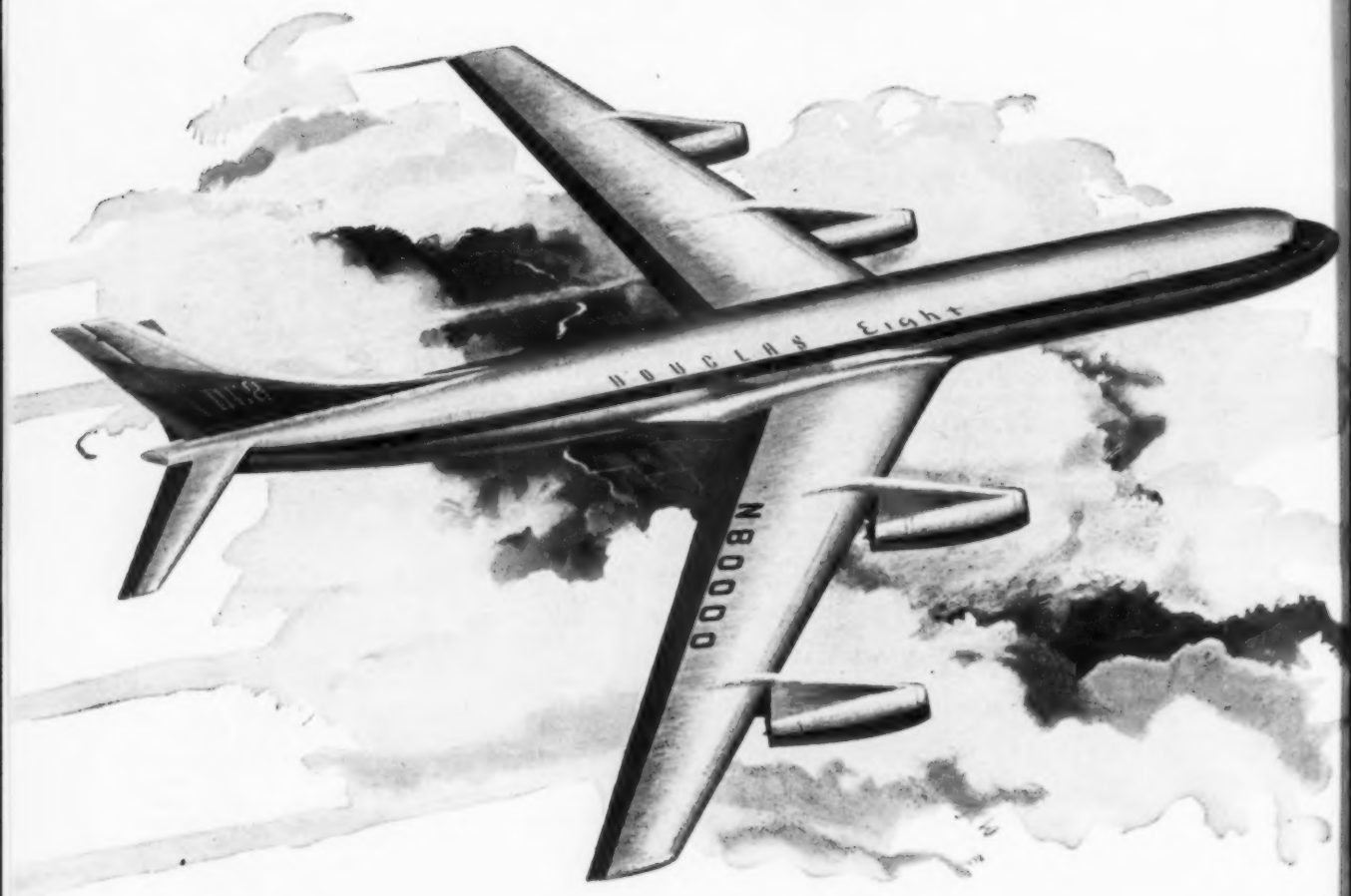

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pact forces that severely damaged the overhead panel upon which the feathering switch was mounted.

Examination of the wreckage disclosed no marks of fire that could have occurred prior to impact. Questioning of all witnesses, including available passengers, disclosed that none of them had seen any smoke, sparks, or other indication of real or impending fire during flight.

The right engine had been overhauled by Pacific Aeromotive Corporation on February 9, 1955, 140:54 hours before the accident. At that time both master rods were fitted with bearings reprocessed by the engine manufacturer. Records of this overhaul and of the tests which followed showed that all parts were within manufacturer's limits and that engine performance was normal.

Examination of all maintenance records of the aircraft shows that the last No. 1 check was made three days before the accident when the logged time was 9,849:23 hours, 2:16 hours short of the time when this inspection was due.

Work sheets of the last No. 2 inspection, dated August 23, 1955, and No. 3 inspection, dated July 20, 1955, disclosed that all items written up were repaired, inspected, and signed off.

Review of the flight logs back through August 20, 1955, disclosed no record of any operating difficulty with either powerplant.

Testimony of eyewitnesses made it possible to plot the path of N 74663 back about 3¼ miles from the point of impact. Attachment A shows this portion of the flight path in relation to the runways and to the takeoff path. The position of the aircraft at the time the crew became aware of the emergency and immediately thereafter is not definitely known and that portion of the flight path is not shown.

Tower Operator's Report

As a reconstruction of the radio communications with Currey Flight 24 of September 8, 1955, the following is quoted from the senior tower operator's report:

"At 0751 N 663 was cleared for takeoff runway 15 with a clearance to climb westbound to on top of the haze and smoke. Top of the haze and smoke had been reported to be 2000 feet.

"At approximately 0752 the pilot of N 663 called the tower and requested an emergency landing on runway 7.[a] He did not state the nature of the emergency. Clearance was given to land runway 7, the airport was cleared of other traffic and the emergency equipment was alerted to standby for the emergency at the intersection of the runway.

"At approximately 0755, when the aircraft had not landed and was not in sight of the tower, several calls were initiated to the aircraft but no replies were received.

"At approximately 0756 the pilot of N 663 called the tower and stated that he was going to land on runway 31. (There is no runway 31 at this airport.) At this time the aircraft was sighted approximately one mile southwest of the airport mushing

[a]Control Tower Operator Carl A. Swanson testified later that his recollection of this exchange included the senior tower operator's inquiry, "Is this an emergency?" and the pilot's reply, "It certainly is."

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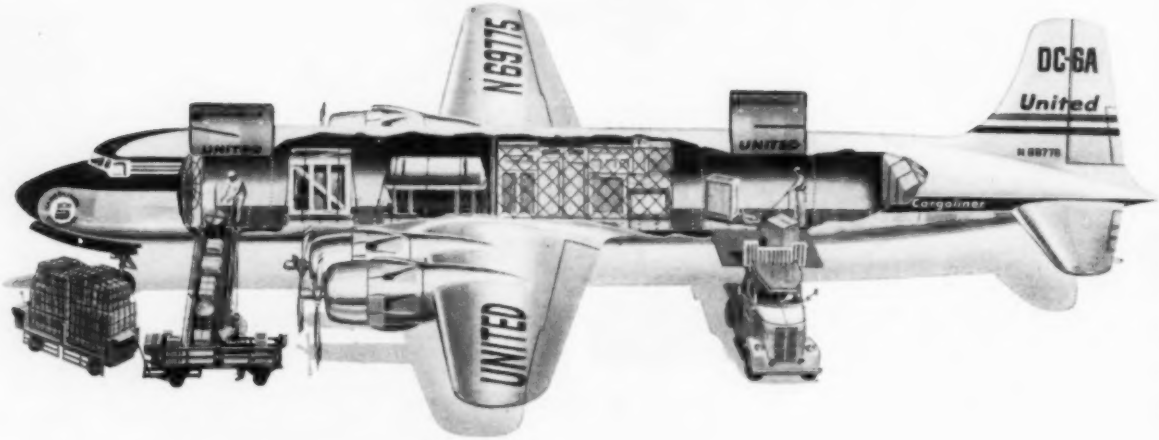

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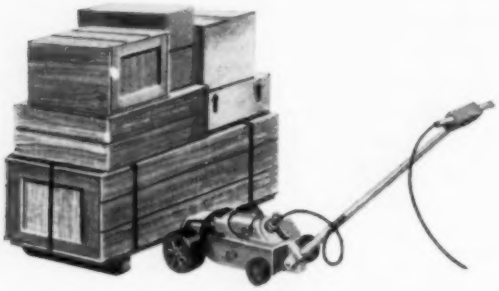

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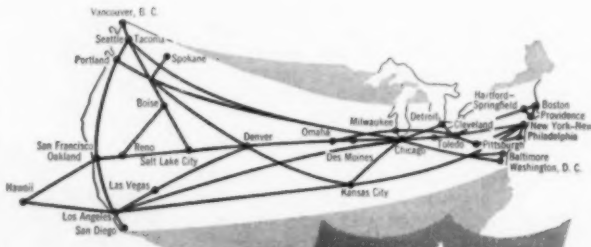

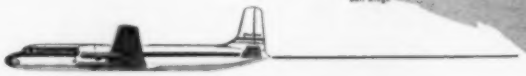

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along in a nose high attitude. At 0757 the aircraft apparently stalled and crashed into the Lockheed Aircraft Service area, located on the southwest side of the airport, causing major damage to two US Air Force C-54 aircraft parked in this area and coming to rest against the corner of a hangar.

"Three fatalities were reported to the tower, Captain Bradsher, Copilot Dutson, and one employee of Lockheed Aircraft Service who was struck by the aircraft. No recording of the tower transmissions is available due to an improperly placed record on the recorder.

"Weather at the time of the incident: 0758. Special observation—Partial obscurement, Ten thousand, broken clouds, visibility one and seven eighths miles, haze and smoke, smoke layer ten thousand." (This concludes the tower controller's report.)

A pilot who had just landed reported that the visibility to the south was worse because of smoke than it was at the airport or to the north. This witness stated that if Flight 24 had as much as 3,500 feet or 4,000 feet forward visibility from the 300-foot level it would be very fortunate.

Several of the ground witnesses described the engine sound and visible rotation of the propellers as normal for the left but slower and irregular for the right. One competent witness stated that the right prop seemed to be "going in and out of feather."

The preponderance of witness testimony indicates that the gear was down and it still was down and locked when the wreckage was examined.

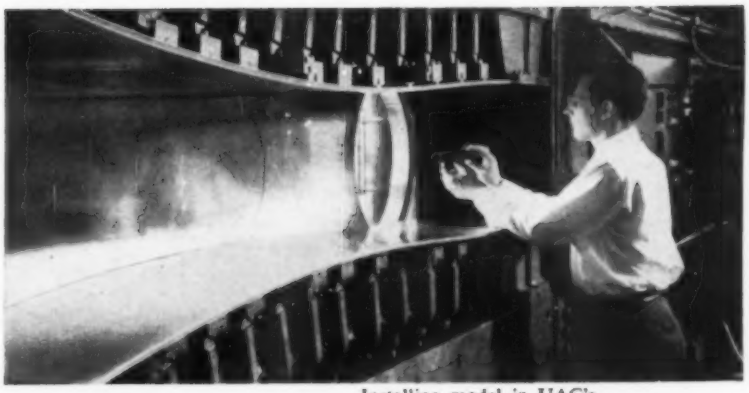
All qualified observers of the emergency approach gave descriptions of the attitude of the aircraft as nose-high and its speed as slow.

Pilot Training Procedure

Chief Pilot Thompson of Currey was questioned regarding the training of Currey pilots. With particular regard to the single-engine procedures training of Captain Bradsher he testified: "These same procedures were given to Captain Bradsher in his training program. In fact, I might admit to the record that he had to perform, to the best of my knowledge, three or four of these maneuvers."

Company training procedure at Lockheed Air Terminal for single-engine return on instruments starts with pilot already under a hood and on instruments. The procedure starts with a climb to 2,000 feet on a course of 255 degrees (parallel to the ILS leg at Lockheed Air Terminal which is 255 degrees outbound). At 2,000 feet and beyond the marker he executes a turn toward the leg and the marker, intercepts the glide path and localizer, and completes his approach. Company method of practicing single-engine return after takeoff is to use a lightly loaded aircraft; it prescribes throttling the engine to little or no thrust in lieu of feathering. Captain Bradsher and Co-pilot Dutson had both been checked out on this procedure.

The chief pilot also testified that he had used the subject aircraft for a 40-minute pilot qualification flight (of another pilot) ending about 30 minutes prior to the takeoff of Flight 24. This training flight utilized a preflight check which in-



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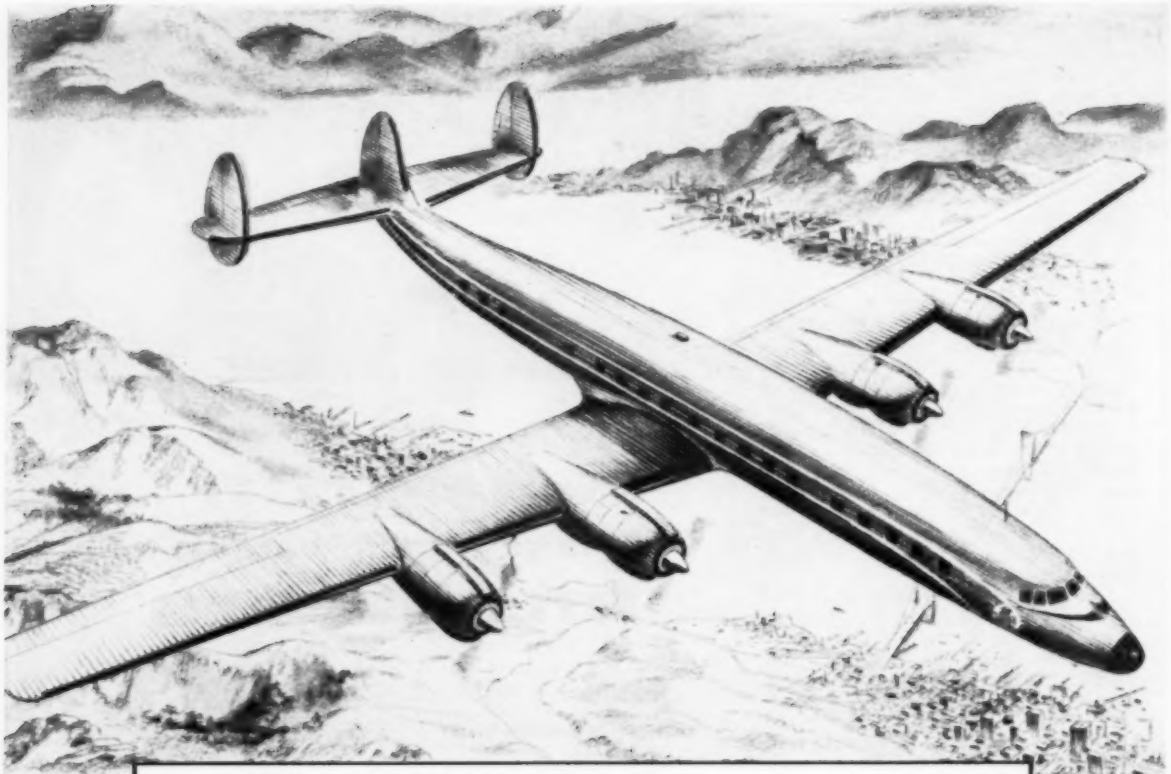

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cluded the functional testing of the feathering of both propellers. (This check is required by the carrier prior to every flight.) No malfunction was noted in engine or propeller performance.

All airborne radio, navigation, and communications equipment was used without malfunction during this flight which included a single-engine instrument approach. During the investigation all airborne radio units were examined and no evidence was found to indicate that it had not been in operating condition prior to impact. Immediately after the accident all ground radio facilities including the ILS for runway 7 were tested; all functioned normally.

ANALYSIS

Since the crew neither survived nor described the emergency by radio it is possible to reconstruct what transpired on the flight deck only by consideration of the factual material already presented. This material includes the following items considered pertinent.

Takeoff was under visual flight rules and was made toward the south-southeast into haze which restricted horizontal visibility and bordered on conditions requiring instrument flight.

There is nothing to indicate that flight by visual references had been discontinued when the emergency was caused by the difficulty with the right engine one to two minutes later.

The malfunction which occurred in the right powerplant would have been evidenced by rising oil temperature, dropping oil pressure, and roughness, all discernible to the pilot. This malfunction did not of itself cause very great loss of power and there is no reason to believe that it included a fire warning. Continued use of power on the right engine for a brief period would have been hazardous but possible. Power reduction at that instant was precautionary.[4] The propeller of this engine continued to rotate until impact; its pitch was then 18 degrees indicating that little or no power was being developed.

This was Captain Bradsher's first takeoff with Co-pilot Dutson. Upon noting the malfunction of his right engine Captain Bradsher asked the tower for and received emergency clearance to return and use runway 7. Runway 7 is the ILS runway and its glide path and localizer were available to guide Flight 24 in establishing alignment and completing its landing.

Aircraft Controllable

The aircraft was loaded close to but within legal limits and the performance of this model so loaded is known to be such that a safe margin exists which would have permitted it to climb on one engine at takeoff power. Under the worst possible combination of propeller and landing gear positions it would have been just able to maintain level flight at METO power if the airspeed was maintained at V_2 (97 m. p. h.) or more.

Climb would have been possible if the gear had been retracted, the propeller had been feathered, or any thrust at all had been developed by the malfunctioning engine.

These known performance data indicate that N 74663 was not incapable of making a safe return after use of its right engine had been discontinued.

As a crew for this operation Captain Bradsher and Co-pilot Dutson had qualifications which met the requirements of CAR and they were properly certificated by CAA.

The observed portion of the flight path, chartered in chart on p. 115, does not include the base leg of the approach.

When the malfunction occurred the captain may have considered his altitude insufficient for safe transition from visual to instrument flight, or for reliance on his co-pilot for much, if any, help on this their first flight together. He may have tried to continue flight by visual references only, or he may have been guided by the ILS inner marker at the approach end of runway 7.

The flight path after the emergency was announced indicated single-engine operation and since the malfunction did not cut out the engine the captain may have reduced power on that engine as done in Currey's practice of single-engine flight; or he may have tried unsuccessfully to feather the right propeller. The fully closed position of the right engine shutoff valves indicates that feathering was attempted. The shutoff valves of the left engine were in a

[4]Cockpit checklist specified "Feather" for single-engine operation; power setting 2,550 r. p. m. and 42 inches; for METO power 2,550 r. p. m. and 41 inches.

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midposition indicating that the crash may have interrupted their closing.

Captain Bradsher did not, and possibly could not, climb to 2,000 feet and follow that portion of the company's single-engine training procedure. He did circle to the right for an approach to runway 7. If he used his radio and the localizer he needed a base leg some distance out to enable him to align the runway by that means. If he depended on visible landmarks he needed a base leg close in to identify known landmarks as aids in accomplishing alignment. It is possible that the base leg he selected was too close in for the one technique and too far out for the other. In any event, alignment was not accomplished.

Although he failed to establish alignment with runway 7 he did turn to a heading of approximately 76 degrees, parallel to runway 7, then lowered the gear and descended. Discovering this misalignment he elected to use No. 33 (misnamed No. 31 when informing the tower).

He changed heading to approximately 30 degrees, toward the airport. Because of the extended gear, the unfeathered right propeller, and the low airspeed then remaining, he was unable to maintain level flight but continued to the airport area, losing altitude all the way, and failed to clear the last powerline in his path.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The carrier, the aircraft, and both pilots were properly certificated.
2. The flight was loaded within allowable limits and the load was properly distributed.
3. All radio aids on the ground were functioning normally and those on board N 74663 were in operating condition.
4. Overheating of the right engine's rear master rod and loss of much of its bearing metal constituted a failure which foretold imminent internal destruction of that engine.
5. Feathering of the right propeller was not accomplished and that propeller continued to rotate (windmill).
6. The aircraft when observed approaching the airport had its gear extended, its attitude was excessively nose-high, and it was not aligned with any runway.
7. The left wing of the aircraft struck a powerline.
8. Forward motion continued; the aircraft stalled and collided successively with two parked Air Force aircraft, the apron, and Lockheed Service Hangar No. 24.

PROBABLE CAUSE

On the basis of all available evidence the Board determines that the probable cause of this accident was the captain's irrevocable commitment to a landing without radio or visual confirmation of his runway alignment following engine failure immediately after takeoff. A contributing factor was engine malfunction immediately after takeoff in near minimum visibility.

By the Civil Aeronautics Board:

Ross Rizley
Joseph P. Adams
Chan Gurney
Harmar D. Denny

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident shortly after it occurred and an investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended.

A public hearing ordered by the Board was held at Burbank, California, on October 26, 1955.

Air Carrier

Currey Air Transport, Ltd., is incorporated under the laws of the State of Illinois and has its principal place of business at Burbank, California. It operates under Letter of Registration No. 1471, issued by the Civil Aeronautics Board, and an Air Carrier Operating Certificate No. 3-273, issued by the Civil Aeronautics Administration.

These certificates authorized the company to fly persons or property internationally, overseas, and over various routes in the continental United States including the route involved.

Flight Personnel

• **Captain Joseph A. Bradsher,** age 31, was employed by the company on September 1, 1955. He held a currently effective airline transport certificate with an appropriate rating for the subject aircraft. Company records showed that he had a total of 4,500 hours, of which 1,200 were in DC-3s.

His last DC-3 equipment and instrument check was on August 30, 1955. His grades in these checks were recorded as "3" (average) on all items except "attitude" which was recorded as "2" (above average) and "tracking" which was recorded as "4" (below average). His final grade for this check was 80%.

• **Co-pilot Keith C. Dutson,** age 34, was employed as a co-pilot by the company on August 11, 1955. He held a currently effective commercial certificate issued by the Civil Aeronautics Administration. Company records showed he had a total of 2,880 hours, of which 120 hours were as copilot in DC-3s. His last CAA physical examination was accomplished July 6, 1955.

His last DC-3 equipment and instrument check was on August 11, 1955. Grades in these checks were recorded as "3" (average) on all items except "Oral," "Traffic patterns," "Landing techniques," and "Smoothness and Coordination," which were recorded as "4" (below average), and "appearance" and "attitude" which were recorded as "2" (above average). His final grade for this check was 78%.

The Aircraft

The aircraft, N 74663, a Douglas DC-3, was owned by Kearn, Inc., and leased to Currey Air Transport, Ltd. The aircraft was currently certificated by the Civil Aeronautics Administration and had a total of 9,849:23 hours.

Both engines were Pratt and Whitney model R-1830-65-92. The left, serial No. BP-450209, has been flown 848:34 hours since overhaul; the right, serial No. BP-437481, had been flown 140:54 hours since overhaul.

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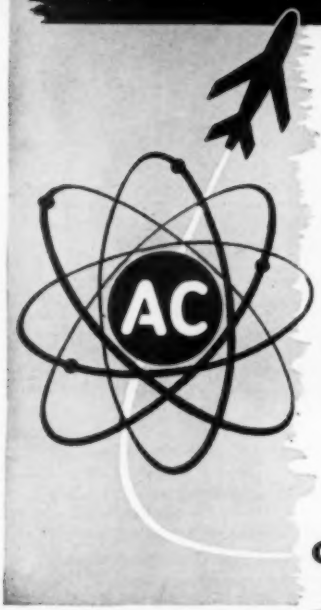

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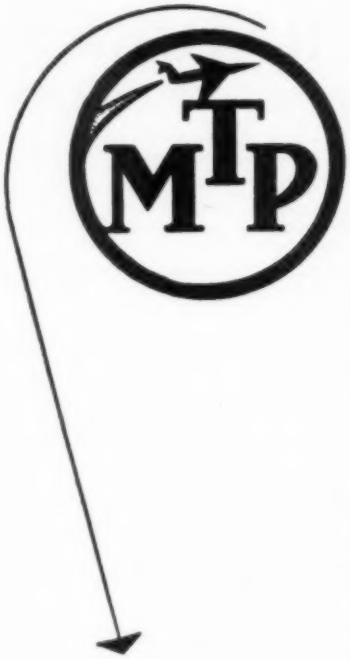

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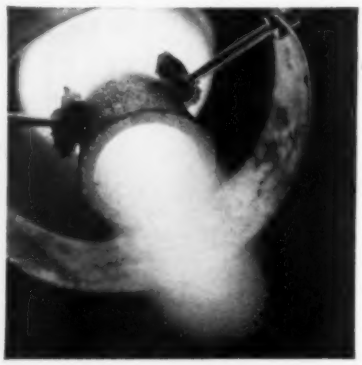

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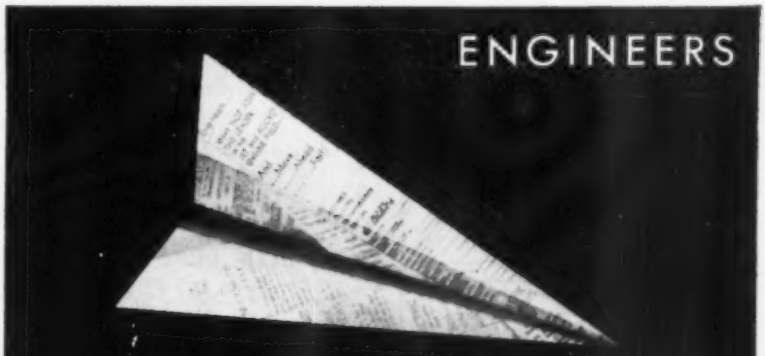

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Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

S & S Machine Co., 7th & Cheltenham Ave., Philadelphia, Pa., tow bar assys., (IFB-383-401-56), 10,000 ea., $46,000.

Safe Flight Instrument Corp., 4 Water St., White Plains, N. Y., transducers for S2F-1,-2 aircraft, (383/2120-519/51, 383/2120-444/52, 383/2120-182/53), 108 ea., $31,235; computers for S2F-1,-2 aircraft, (383/2120-513/51, 383/2120-434/52, 383/2120-168/53), 108 ea., $39,277.

North American Aviation, Inc., Columbus Div., 4300 E. Fifth Ave., Columbus 16, Ohio, armament parts, (383/29047-12A6/3/56), various, $95,413.

Ronnwell Corp., 662 Pacific St., Brooklyn, N. Y., microphone assys., (PREN11-755/56), 12,616 ea., $74,813.

Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst 73, N. Y., regulators for R6D-1,-1Z aircraft, (383/2120-609X6/3/51), 86 ea., $38,818.

Industrial Hard Chrome Plating Corp., 1401 Park Ave., Emeryville 8, Calif., services (383/23055-4*2/1/56), 4,000 ea., $228,000.

Utica Div., Bendix Aviation Corp., Utica, N. Y., maintenance parts, (383/2117-190/50), various, $26,966.

Lear, Inc., 110 Ionia Ave., N.W., Grand Rapids 2, Mich., screwjacks for various aircraft, (383/29043-38X1/1/56), various, $26,456.

Aviators Clothing Co., Inc., 143 Main St., Beacon, N. Y., coveralls for flying (IFB-383/470-56), various, $46,187.

Belleville Shoe Mfg. Co., Main & Walnut St., Belleville, Ill., flight deck shoes, (IFB-383/363-56), 34821 prs., $210,841.

Dispensers, Inc., 847 East 62nd St., Los Angeles 1, Calif., rocket launcher kits, (IFB-383-245-56), 776 ea., $27,455.

Sperry Gyroscope Co., Marcus Ave., & Lakevill Rd., Great Neck, L. I., N. Y., radar test sets, (288/9800-103/55), 5 ea., $138,250.

American Alkyd Industries, Broad & 14th St., Carstadt, N. J., alkyd resin solution, (155/168007F/56), 660,000 lb., $91,608.

Bakelite Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y., resin, (155/168002F/56), 79,000 lb., $33,180.

Continental Screw Co., 459 Mt. Pleasant St., New Bedford, Mass., screws, (IFB-383/268-56), various, $26,622.

Stratoflex Inc., P. O. Box 10398, Fort Worth, Tex., fitting ends, (IFB-383-271-56) various, $32,247.

Worthington Corp., 401 Worthington Ave., Harrison, N. J., compressors, (IFB-383-159-56), various, $615,535.

Benjamin Franklin Paint & Varnish Co., 4820 Langdon St., Philadelphia 24, Pa., enamel, (IFB-383-300-56), 22,000 gal., $42,900.

Hub Paint & Varnish Co., Inc., 47-38 Fifth St., Long Island City 1, N. Y., enamel, (IFB-383-51-56), 23,139 gal., $50,767; (IFB-383-300-56), 32,000 gal., $75,270.

Atlas Paint & Varnish Co., 3250 Buffington Ave., Irvington 11, N. J., enamel, (IFB-383-50-66), 34,813 gal., $72,411; (IFB-383-300-56), 39,000 gal., $79,610; (IFB-383-84-56), 12,850 gal., $31,652.

Adel Precision Products, Burbank, Calif., valves for various A/C, (383/2150-183/54, 383/2150-524/53, 383/2150-119/52), $82,931.

Lord Mfg. Co., 1635 W. 12th St., Erie 6, Pa., isolators for various A/C, (383/2150-620X7/3/50), $31,799.

B. F. Goodrich Co., 500 S. Main St., Akron 18, Ohio, de-icer boots for various A/C, (383/2150-1404 X 7/3/51), $35,356; de-icer boots for R5O A/C, (383/2150-1527 V /3/51), various, $141,723.

Transitron Inc., 119 Wooster St., New York, N. Y., testers, Model T-4, (383/23263-64 S 2/16/17/56), 301 ea., $84,882.

AiResearch Mfg. Co., Div. of Garrett Corp., 9851-9951 Sepulveda Blvd., Los Angeles, Calif., services, (383/23055-15 X 7/1/56), various, $191,016.

American Bosch Arma Corp., 3664 Main St., Springfield 7, Mass., magneto assys., (383/2116-92 X 5/4/51), 273 ea., $65,296.

A. C. Spark Plug Div., Milwaukee, Wis., regulators for F6F-5K A/C, (383/29023-38 X 3/4/56), 203 ea., $81,606.

C. B. Christiansen Co., 164 Pennington St., Newark 5, N. J., ground handling equipment (383/2110-1752/52), 59 ea., $69,915.

Atlas Paint & Varnish Co., 32-50 Buffington Ave., Irvington, N. J., enamel, (IFB-383-336-56), 48,648 qt., $29,919; (IFB-383-313-56), 23,862 gal., $50,191.

Lewis Engineering Co., 339 Church St., Naugatuck, Conn., bulbs, temperature, cylinder head, (IFB-383-288-56), 6,459 ea., $32,101.

United States Gauge Div., American Machine & Metals, Inc., Sellersville, Pa., transmitters, (IFB-383-344-56), 1,114 ea., $68-433.

Jack & Heintz, Inc., 17600 Broadway, Cleveland, Ohio, tachometer generators,

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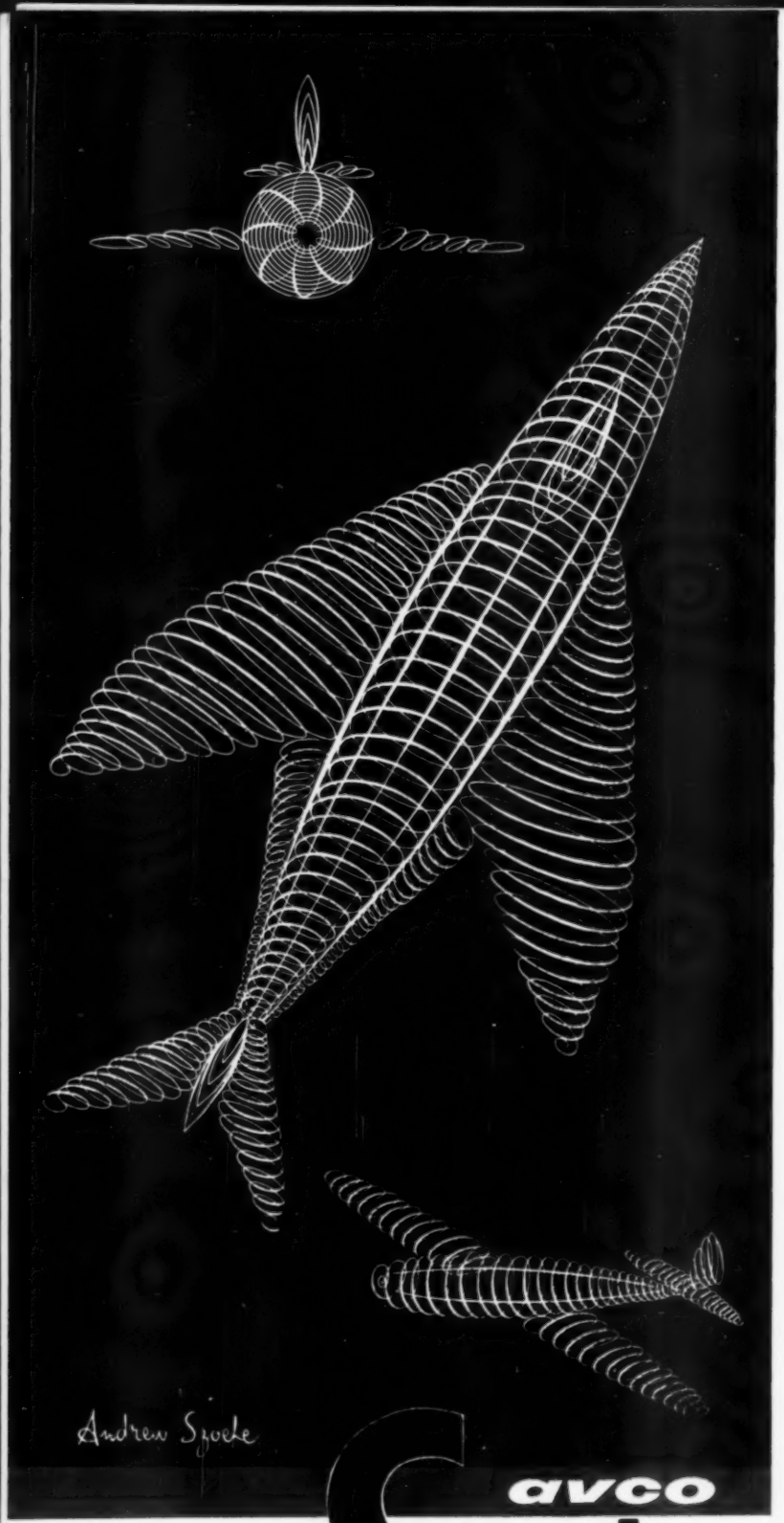

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(IFB-383-193-56), various, $42,476.

Reliance Chemical Co., Lee Terminal-Standiford Ft., Louisville 13, Ky., enamel, (IFB-383-79-56), various, $62,405.

Benjamin Franklin Paint & Varnish Co., 4820 Langdon St., Philadelphia 24, Pa., enamel, (IFB-383-313-56), 60,995 gal., $125,348.

Grumman Aircraft Eng. Corp., Bethpage, L. I., N. Y., lobe switch assys., (383/2130-584 E 3/3/52), 39 ea., $44,165.

Burgess Battery Co., Freeport, Ill., batteries used on radiosondes, (383/23371-4 G 6/2/56), 14,000 ea., $37,100.

United States Gauge Div., American Machine & Metals, Inc., 48 Thomas St., East Moline, Ill., indicators, (IFB-383-359-56), 1,662 ea., $56,093.

Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J., conduit assys., (383/2116-41/54), various, $42,909.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., indicators, (383/2120-589/51, 383/2120-25/55), various, $29,076.

Cleveland Pneumatic Tool Co., 3781 East 77th St., Cleveland 5, Ohio, arm assys., (383/2150-1286/52), 109 ea., $29,185.

Sundstrand Aviation Div., Sundstrand Machine Tool Co., Rockford, Ill., maintenance parts used for transmission and governor assys., (383/2150-560/53, 383/2150-194/54), various, $79,505.

Pacific Div., Bendix Aviation Corp., North Hollywood, Calif., actuators, (383/2150-576/53, 383/2150-1174/52, 383/2150-1174/52, 383/2150-1172/51), 756 ea., $81,066.

OFFICE of NAVAL RESEARCH, Washington 25, D. C.

University of Illinois, Urbana, Ill., research on the development of radio wave direction finding techniques, $75,000; research on methods of analysis of structural and machine methods, $62,590.

University of California, Berkeley, Calif., research in the theory of mathematical statistics, $112,197.

Carnegie Institute of Technology, Pittsburgh, Pa., research on effects of aluminum additions on phase transformation in titanium alloys, $40,000.

Brown University, Providence, R. I., research on the transmission of ultrasonic radiation through solids, liquids and gases, $83,690.

BUREAU OF ORDNANCE, Washington, D. C.

Hycon Mfg. Co., Pasadena, Calif., spare parts for CAG guided missile test equipment and CAG supporting equipment, NOrd-16413, $161,528.

RCA Service Co., Inc., Camden, N. J., engineering, drafting and technical writing services in connection with the planning and installation of general and surface fire control equipment, NOrd-16592, $429,401.

Associated Missile Products Corp., Pomona, Calif., CAG-1 telemetering ground station recording equipment, NOrd-16684, $25,517.

Elgin National Watch Co., Elgin, Ill., procurement of guided missile fuzes and safety and arming devices, NOrd-16698, 310 ea., $163,801.

Massachusetts Institute of Technology, Cambridge, Mass., study, analysis and design of missile and gun integrated control systems, NOrd-16708, $191,331.

General Electric Co., Washington, D. C., d.c. power drive Mk. 35 conversion kits for 3"/50 caliber (RF) twin mounts, NOrd-16717, IFB Neg. Ma5a/56-10, $912,092.

Methods Engineering Council, Pittsburgh, Pa., installation of cost reduction and cost control procedures at U. S. Naval Ordnance plant, Macon, Ga., NOrd-16754, $41,280.

California Institute of Technology, Pasadena, Calif., investigate fundamental and design problems relative to the hydroballistics of projectiles, bombs, underwater rockets and related vehicles, NOrd-16200, $46,000.

Aerojet General Corp., Azusa, Calif., research on rocket boosters, Dwg. P-023523, NOrd-16657, $55,160.

Sperry Gyroscope Co., Div. of Sperry-Rand Corp., Great Neck, L. I., N. Y., development and fabrication of driver tubes for radar set AN/SPG-49, NOrd-16674, $97,408.

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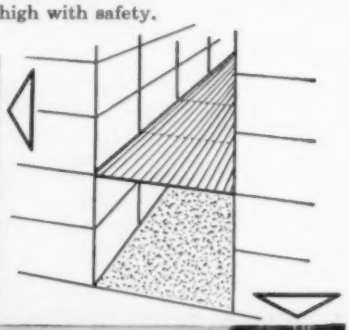

Top row of Cargotainers can be reached easily by means of the catwalk seen above. Below is how bottom row looks in the tiered storage area.

Builder Uses Pittsburgh Steel Containers To Cut Storage Costs

Keeping the sleek, six-jet B-47 bomber fully modified and in tip-top readiness presents a king-sized materials handling problem to production engineers at Douglas Aircraft Company's huge Tulsa (Okla.) Division.

Some 35,000 different parts must be kept quickly available—some for as long as two years, others for only 24 hours. They are used in the U.S. Air Force-owned plant which Douglas operates in the continuing Air Force Overhaul and Modification Program for the big Stratojet.

Douglas appraised its parts-handling problems and came up with a solution: use of sturdy, steel mesh Cargotainers made by Pittsburgh Steel Products, a division of Pittsburgh Steel Company.

Using Cargotainers gave Douglas an aircraft industry engineering "first," but more important, they cut per item storage costs as much as 75 percent when compared with wooden box storage bins they replaced.

B-47's, currently the Strategic Air Command's prime airplane, come to Tulsa periodically from bases all over the globe to be brought up to the minute with the steady stream of aeronautical advances. Until they land at Tulsa, however, Douglas does not know the exact extent of up-dating each plane will require.

Sometimes, the big ships bring along their own modification parts; other times, parts come to Tulsa from the plane's original builder, from a subcontract supplier or from other Air Force sources. Whatever their origin, the parts must be stored efficiently and economically.

That's what prompted Douglas to make a close study of its materials handling system. Douglas determined that its parts storage units had to be highly portable, use as little space as possible and be extremely versatile.

Open end Cargotainer makes for easy access when containers are used as storage bins. Note horizontal separator.

Standard horizontal and vertical dividers can be used in a variety of combinations to compartmentalize contents.

At first, Douglas tried wooden boxes, stacking them in twin tiers four boxes high. Cost of each 3½′ x 4′ x 4′ wooden box ranged from $36.50 to $38, recalls Jack W. Byrd, general foreman of manufacturing control. It wasn't long before Douglas had a record of these disadvantages:

1. Heavy loads tended to split the boxes.
2. Using a fork truck to move the containers many times severely damaged the bottom box.
3. To use dividers or separators required expensive, space-consuming additions to the boxes.
4. Wooden boxes had no salvage value.
5. Wooden boxes were dirt-collectors, required regular painting and maintenance.
6. General fragility constituted a safety threat and the wood was a fire hazard.
7. Artificial lighting was required to illuminate box interiors sufficiently.

Pittsburgh Steel Products knew its Cargotainers could eliminate these objections. Douglas ordered 94 standard 48″ x 48″ x 36″, 2,000-pound capacity, Strip-Base Cargotainers. One end was cut out, leaving four inches of fabric on both sides and across the top for extra strength.

The Cargotainers were equipped with half and full vertical dividers, as well as full horizontal separators, giving maximum use of the cube, regardless of size, shape or number of parts to be stored in them. Horizontal separators, placed on two-inch centers, provide shelves, while vertical dividers make pigeonholes for odd-shaped flat parts.

Douglas engineers then devised a sturdy, but easily dismantled catwalk for quick safe access to the top two Cargotainers in the four-high stack.

Cost of the Cargotainers averaged $40 each, only $2 more than the unsatisfactory wooden boxes they replaced.

Douglas has 14 feet of vertical storage space with Cargotainers. In one common parts size range, lack of dividers and separators limited a wooden box to one item, four to a tier. With Cargotainers' dividers and separators, it was possible to put four of the same items in one unit. That meant 16 per tier.

Cargotainers, then, meant a 75 percent reduction in per item storage costs.

Besides being strong enough to contain parts weighing up to 200 pounds each—as in the case of ballast weights—the Cargotainers are a safe, fireproof storage unit.

They can be tiered handily by a fork lift truck. They can be moved empty from building to building, plant to plant, if necessary, on a flat trailer hauling 96 knocked-down Cargotainers, compared with 14 of the same size wooden boxes.

Cargotainers provide easy visual inventory without extra artificial lighting. They do not collect dirt, nor do they require painting of their aluminum-dip, maintenance-free finish.

Two men can assemble a Cargotainer in 45 seconds, Douglas found.

Douglas' study of Cargotainers, extensive on its initial use of them, came up favorable on all counts. Thus, Cargotainers got the best vote of confidence they could receive—a second order was placed, and this time, the Cargotainers went to the Design and Test Operations Division.

Cargotainers have racked up similar success stories in every industry they've entered, thanks to the inherent advantages of the product and the experienced, skilled engineers Pittsburgh Steel Products has available to tackle materials handling problems. Give Cargotainers a chance to improve your materials handling while you save money. A phone call to any Pittsburgh Steel Products sales office listed in this ad will put you on your way to a profitable, lasting solution of materials handling problems.

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terms of the capital needs arising from

CAB Splits Over Re-Equipment Plan

Airlines face strong opposition in bid to retain equipment sales' earnings without subsidy loss.

Washington—Subsidized airlines face strong government opposition in their drive for legislation that would authorize them to retain earnings from aircraft sales to finance new equipment without any reduction in subsidy allowances.

The Civil Aeronautics Board has disallowed earnings from aircraft sales in considering the subsidy need of carriers on open mail rates. However, since sales could not be predicted, the Board has not reduced the subsidy allocations of carriers on final rates. To correct this discrepancy and to work out an equitable policy on equipment-sales profits, the CAB reopened the rates of all 33 subsidized carriers on April 6.

Senate Supporters

Legislation introduced in the Senate by Sen. Warren Magnuson (D.-Wash.), chairman of the Senate Commerce Committee, directs the CAB to disregard equipment profits "for a reasonable time" in setting subsidies.

Other sponsors of the measure are Sen. Mike Monroney (D.-Okla.), Sen. George Smathers (D.-Fla.), Sen. Alan Bible (D.-Nev.), Sen. John Bricker (R.-O.), Sen. Andrew Schoeppel (R.-Kans.) and Sen. Frederick Payne (R.-Me.), all members of the Commerce Committee considering the legislation.

On the House side, the measure has been introduced by Rep. Oren Harris (D.-Ark.), chairman of the Commerce Aviation Subcommittee, and by Rep. Carl Hinshaw (R.-Calif.), ranking minority member.

Commerce Opposition

The Commerce Department, General Accounting Office and two members of the CAB (outgoing Chairman Ross Rizley and Joseph Adams) opposed the legislation in statements before the Commerce Committee. It was supported by CAB members Chan Gurney and Harmar Denny.

The legislation, Rizley and Adams declared, "Would in effect disregard the actual need of the particular carrier seeking subsidy support by prohibiting the Board from looking at the profits from the sale of equipment—the very same equipment which, through depreciation allowances, already might have been paid for by the traveling public and the government through its award of subsidy. Whether or not a particular carrier needs it or not, it would get to keep the profit anyway." They suggested that it also might open the way for some carriers to get "windfalls."

The two Board members said the legislation would be discriminatory because equipment profits would depend upon the market prices at the time the equipment is retired. "This discriminatory aspect," they said, ". . . might induce carriers to risk over-equipping or to re-equip too soon . . . and might thus encourage uneconomic practices."

Urging enactment of the legislation, Gurney and Denny said: "The air transportation industry is faced with re-equipment programs that far exceed its present total investment in aircraft and will require capital commitments on a scale which will tax every resource of the industry. . . . We cannot blind ourselves to the wholly unprecedented situation which now faces the air transport industry and must devise policies which will assure the success of the pending re-equipment programs. . . ."

They maintained that permitting the industry to make equipment sales without having them affect subsidy is only a practical step to assist the local-service carriers.

Testimony Highlights

In addition, the CAB members recommended enactment of legislation granting the Civil Aeronautics Administration $25 million to partially finance the development costs on prototypes designed for local service (AW Apr. 9, p. 27). Denny also proposed legislation providing for government guarantee of private loans to local lines to encourage equipment financing.

Spokesmen for subsidized international carriers, Alaskan carriers, helicopter operators and local-service airlines called for prompt enactment of the equipment-sales legislation at Congressional hearings. Testimony highlights included:

• **Stuart G. Tipton**, president of Air Transport Assn., emphasized that the re-equipment problems of the airlines are not limited to replacement of existing capacity but are further aggravated by the necessity of providing "more and more capacity to meet the growing demands." Between 1946 and 1955, he said, the investment of international carriers has increased from $21 million to $126 million; the investment of local service lines, from $2.7 million to $27 million.

Tipton anticipated that "one of the very big re-equipment programs which will take place within the next year or so is the replacement of helicopters" by the three carriers in the Los Angeles, Chicago and New York areas.

He urged that hangar, as well as aircraft equipment, sales profits be made available for re-investment and not be deducted from the subsidy allocation.

• **John Floberg**, counsel for the Conference of Local Service Airlines, reported that "unless (the feeders) are relieved of the threat of having the capital gains which they expect to realize on equipment sold, their ability to arrange any financing plan for the purchase of new modern equipment is likely to be indefinitely postponed and the date of their subsidy free operation delayed."

• **Theodore Seamon**, representing Northern Consolidated Airlines, Wien Alaska Airlines and Alaska Coastal Airlines, said these carriers needed the equipment-sales legislation to move forward with their plans to re-equip their fleets, particularly with Frye Aircraft Corp.'s F.1 short-haul transport (AW April 16, p. 39) costing $400,000 each.

• **Kenneth Lawder**, Pan American Grace Airways vice president, said Panagra was able to arrange bank credits "on very favorable terms" to finance its $12.5 million DC-7B program only because it could report to the banks that the proceeds after taxes from DC-6 sales would be available to finance the program.

Since the CAB re-opened all mail rates of subsidized carriers, Lawder said, "It is now by no means clear that we will be able to use these capital gains from the DC-6 aircraft to finance the new aircraft."

Weeks' Reason

Other industry statements to the committee were made by Robert Six, president of Continental Airlines; Robert Ferguson, treasurer, Pan American World Airways; William Hogan, Treasurer, New York Airways, and C. M. Belinn, Los Angeles Airways.

In opposing the equipment-sales legislation, Commerce Secretary Sinclair Weeks noted "the problems facing all of the air transportation industry in

terms of the capital needs arising from technological advances." But these, he said, will not be solved "merely by increasing the government's potential subsidy obligations in a very limited area." He urged that the CAB be permitted to go forward with its investigation to work out an equitable policy on equipment financing for the subsidized lines.

Comptroller General Joseph Campbell warned that the equipment-financing legislation might result in "an unwarranted burden upon the taxpayer" by increasing airlines subsidies. If subsidies are to be paid to air carriers on the basis of their "need," he said, equipment-sales profits, as well as other revenues, should be considered in determining the "need."

CAB Seeks Regulation Of Schedule Reliability

Washington—A long-expected rule setting standards of airline schedule reliability has been proposed by the Civil Aeronautics Board. The rule would require 75% on-time completion of passenger flight schedules, or a revision of schedules.

The new regulation, proposed as Part 234 of the Economic Regulations, applies to any certificated carrier in interstate or overseas operation. All-cargo flights are specifically excluded.

In the present stage of airline development, the CAB said, passengers should be able to rely on published schedules. The Board also said unrealistic schedules may subject competing carriers to unfair competition.

Under the new rule, the airlines would have to set schedules capable of being completed on-time at least 75% of the time every month. If schedules failed to meet this standard, they would be considered unrealistic, and the airline would be violating the regulation.

The airlines would then have the opportunity to justify a failure to meet the 75% standard by proving the violation was caused by conditions beyond their control.

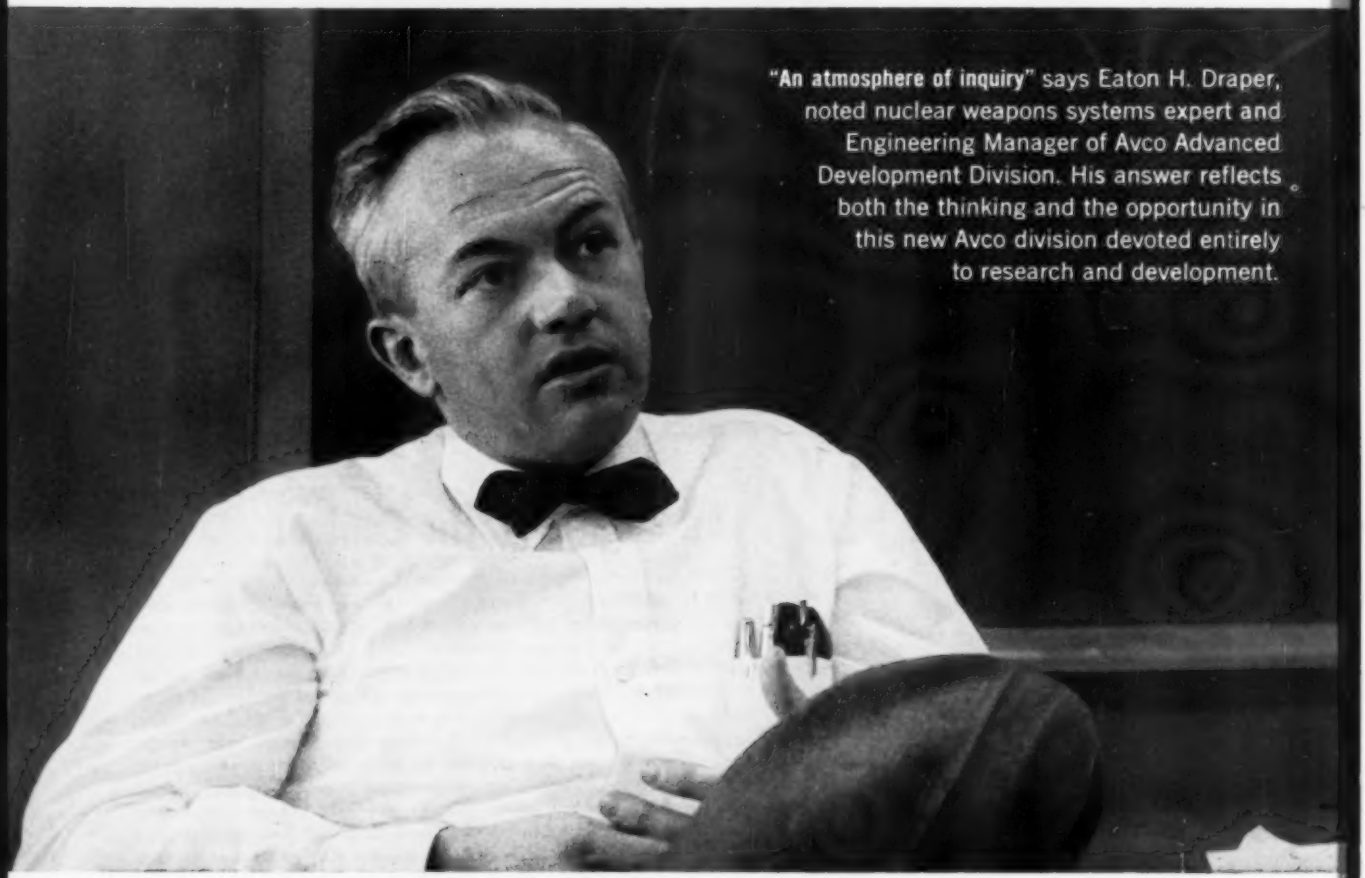
In judging schedules, the CAB would term a flight that departs no earlier than its specified time an on-time flight. An on-time flight also would have to arrive at its destination no more than five minutes later than its scheduled time. Flights longer than 1,000 miles would have an allowable time lapse of 15 minutes after scheduled arrival time to meet the on-time requirement.

An airline which violated the regulation and couldn't justify the failure to meet its schedules would have to change them or be subject to a CAB enforcement proceeding.

Automatic Traffic Control

New Volscan, first of three production prototypes, can automatically schedule the flow of traffic into an airport at rates up to 120 aircraft per hour. Patterned after the original Volscan developed by Air Force Cambridge Research Center, the new prototypes are being built by Crosley Division of Avco Manufacturing Co. Unit shown above will soon be installed at Clinton County (Ohio) Airport for USAF evaluation. Aircraft picked up on a surveillance radar are introduced into Volscan system by console operator pointing small light gun at aircraft blip on radar scope. Computer then automatically determines earliest non-conflicting arrival time for the new aircraft and calculates what path it must fly to arrive at approach gate at prescribed time. Required flight path is visually indicated to relay operators (below) who radio information to individual pilots. The Crosley-built Volscans incorporate several new features including ability to compute both short and long-radius turn-on path for prop and jet aircraft, automatic warning of possible altitude conflict between aircraft, and indicating lights to show speed of each airplane under Volscan control. The new units can handle 14 aircraft simultaneously, compared to only six in the original experimental model.

what helps an engineer grow?



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CAA Borrows B-47 to Check Jet Problems

By Glenn Garrison

Philadelphia—CAA teams soon will bring an Air Force Boeing B-47 into civil airports to study the particular problems of forthcoming jet operations, Civil Aeronautics Administrator Charles J. Lowen told the Airport Operators Council last week.

Speaking at AOC's Ninth Annual Conference, Lowen said that the B-47 will be "in our hands" in about 60 days to further a practical service study of major jet transport problems. The CAA will take the aircraft into the New York area "squirrel cage" and other metropolitan airports after the teams have been familiarized with its operation at the Air Force B-47 school.

(John R. Wiley, Port of New York Authority Director of Aviation, later said the PNYA's ban on jets with present noise characteristics would apply to the CAA B-47 if unmodified, but was sure Lowen's teams would use other airports unless their aircraft were modified to meet PNYA tolerable noise level requirements.)

In addition to the B-47 and other jet aircraft, including a B-57, which CAA expects to acquire on loan from the Air Force, the agency is arranging to "beg, borrow or steal" a prototype commercial jet to run actual scheduled test operations, Lowen said. The airport operators will be asked to participate in the CAA jet studies, and the airlines "are going to have to come up with some of the answers, too."

100 Problems

Use of the B-47, Lowen said, will provide information on what the airport of the future must be.

There is still time to plan for the advent of the new aircraft, the CAA official pointed out. His agency has been studying the jet for five years, and has identified the new problems "one by one," coming up with a total of a hundred problems including traffic control, safety, noise, runway limitations, passenger terminal and other airport facilities.

CAA must determine what part federal funds are to have in "many aspects of a different kind of airport." A bright spot in the jet picture, he noted, is the opportunity to plan for three years ahead with solid assurance of the availability of federal aid.

AOC panel discussions covered capital financing, federal aid, new aircraft developments, terminal area planning, airport design and other airport problems.

Among statements of the problems resulting from vast expansion and radical new types of equipment which face the operators, were the following:

• **Edward P. Curtis,** special assistant to President Eisenhower for Aviation Facilities Planning, emphasized that future airport development must be planned as an integral part of the nation's aviation facilities system, along with airways, navigation and communication systems commonly used by civil and military aircraft operators.

His office will work closely with the Air Coordinating Committee, CAA, Air Navigation Development Board and other industry, government and military groups, Curtis said, but such organizations are concerned with the immediate problems in their own fields of responsibility, whereas his office is responsible for overall planning. A second difference, the Presidential assistant said, is that he has the clear responsibility and authority to make final decisions.

• **Dr. Edward P. Warner,** president of International Civil Aviation Organization, reported that an ICAO group will meet next March to study "pressing problems" established by its Air Navigation Commission, including heliport standards, standardization of approach lighting, runway standardization matters, including runway strengths, and airport rescue and firefighting equipment. Another ICAO group meeting has been scheduled for October to study the "urgent" matter of airport charges.

The ICAO official does not feel that his organization, or any agency of an individual government," could reasonably be expected" to do anything about limiting runway lengths, as ICAO has frequently been requested to recommend.

• **Herbert H. Howell,** director of CAA's Office of Airports, reviewed developments since the Federal Airport Act amendments of 1955, and estimated that about $75 million will be put under grant in 1957 as the airport program "gets into full swing." The 1957 program should be announced soon.

• **Stuart G. Tipton,** president of the Air Transport Association, again emphasized the need for a bold, new electronic system of air traffic control to accommodate the volume of future traffic and the new types of aircraft included in it.

• **John Leonard,** vice chairman of the Helicopter Council of Aircraft Industries Association, presented a paper for Don R. Berlin, chairman of the council, which urged the airport operators to take a major role in helping city planners designate downtown heliport sites and determine the heliport requirements.

Panel Discussions

There is great need for revisions of state and local aeronautical laws, Leonard said, to distinguish the helicopter from fixed-wing aircraft in defining its limitations.

Present inadequacies and possible means of improving various airport facilities to meet the demands of expected volumes of traffic and the new jet transports were outlined at panels on terminal area planning and airport design. Among the highlights:

• **Randall W. Kirk** of Pan American: Fixed servicing, including pit or hydrant fueling for jets; special facilities for handling all-cargo aircraft; weather protection for passengers; larger loading areas for jets. The jets also present a "most serious" problem regarding inhalation of foreign objects. He suggested one possibility for speeding passenger handling: partially decentralized terminals.

• **Aubrey Keif,** the Texas Company: Hydrant system for fueling jets. A committee of the American Petroleum Institute now is designing a prototype underground jet hydrant refueling system.

• **C H. Taylor,** Capital Airlines: Decentralize some functions now performed at the airport ticket counters; for jets, consideration of using passenger buses between plane and terminal.

• **Walter H. Neff,** United Air Lines (and National Air Transport Coordinating Committee member): More education of the airport community neighbors to aviation goals and needs, and good performance to base the education on; possible annual reports by airport operators for public relations.

• **F. B. Butler,** manager, San Francisco International Airport: Better air cargo handling facilities should be designed into terminals, including development of mechanical devices for moving freight. The concourse or finger type terminal ground plan "is the solution for years to come." Automobile parking facilities are an absolute public necessity and a major source of revenue.

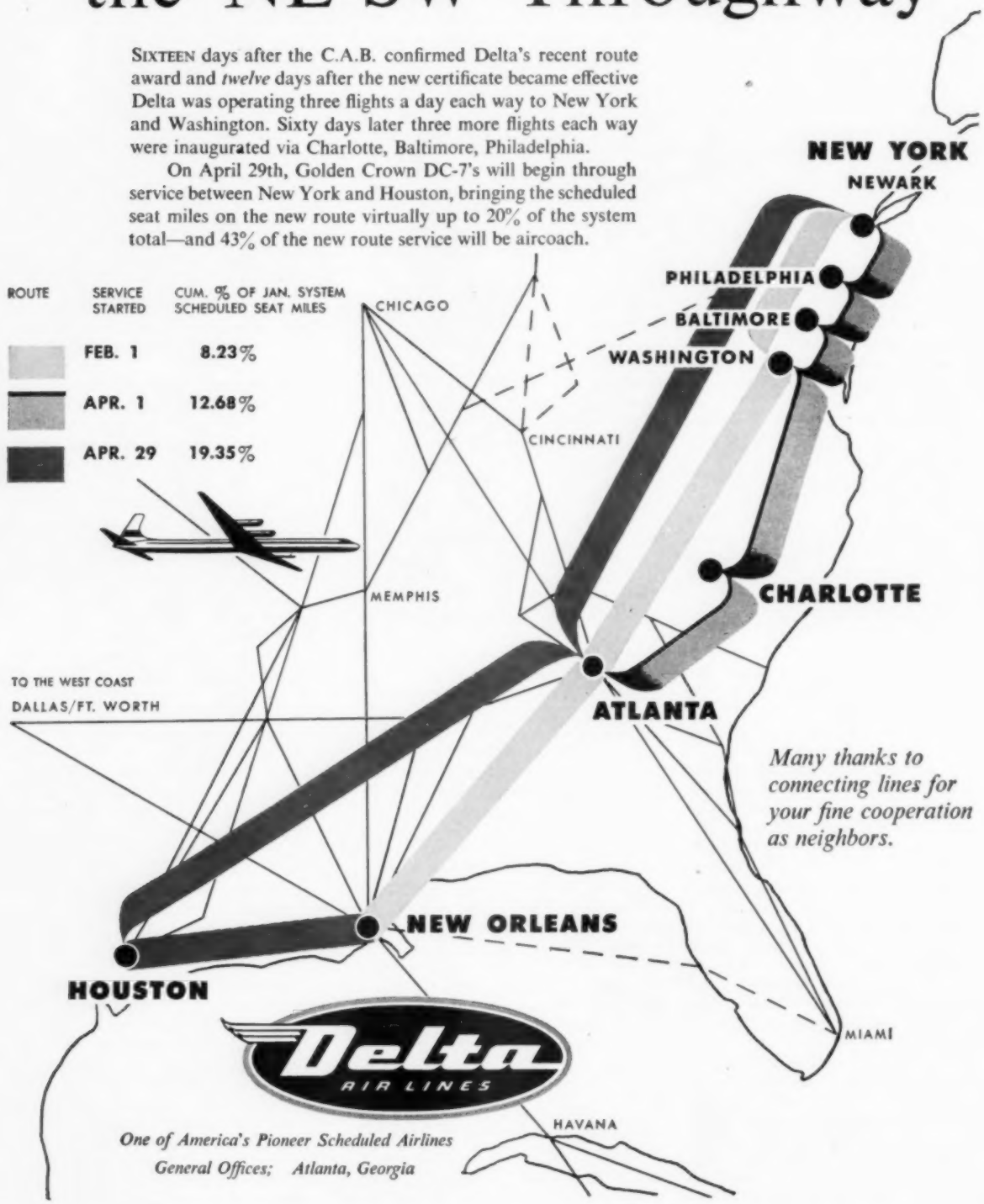
• **Louis R. Inwood,** Director of Aviation, Philadelphia: The most important terminal design feature is expandibility—the design capacity of Philadelphia International Airport is now expected to be reached by 1959 instead of 1980 as planned, but the building can be expanded.

• **Claude F. King,** Commissioner of Airports, Cleveland: All operational areas at Cleveland Hopkins Airport are expandable, and schemes for such increases were recorded and made part of the planning file. The ticketing wing and airline office above it can be expanded by 50%; the service area around the building can be expanded horizontally in three directions; upper floors will take increased concession areas, waiting, dining and CAA space.

DELTA'S timetable on the NE-SW Throughway

SIXTEEN days after the C.A.B. confirmed Delta's recent route award and *twelve* days after the new certificate became effective Delta was operating three flights a day each way to New York and Washington. Sixty days later three more flights each way were inaugurated via Charlotte, Baltimore, Philadelphia.

On April 29th, Golden Crown DC-7's will begin through service between New York and Houston, bringing the scheduled seat miles on the new route virtually up to 20% of the system total—and 43% of the new route service will be aircoach.



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Airlines Report Varied Progress

Varying degrees of progress during the past year of general airline prosperity are shown in the annual reports of four airlines for 1955.

The airlines report increases in traffic, revenues and profits, but the record shows that some failed to match gains made by the industry as a whole. Their reports:

Capital

Capital Airlines' total business last year was $50,849,876, as compared with $48,136,745 for 1954; net profit increased from $1,746,759 in 1954 to $4,135,753 in 1955. Operating profit fell from $2,398,401 to $494,081 in the same period. Capital gains from equipment sales of $4,000,328 in the past year formed the bulk of its net profit.

Capital's traffic for the year totaled 803,921,984 passenger-miles, as compared with 765,240,459 in 1954. The airline carried 2,426,961 passengers in 1954 and 2,570,170 in 1955. The load factor increased slightly from 58.69% to 58.94% in the same period.

The decline in operating profit is attributed to the fact that Capital had to compete with late-model piston equipment used by other carriers without much benefit from its new Viscounts. Viscount operations accounted for only 3% of Capital's total mileage in 1955.

Increased costs and the existence of operating restrictions during most of 1955 are other factors Capital blames for the decrease in operating profit.

Expansion of Viscount operations and the development of traffic on new routes awarded late last year are expected to contribute to an improvement in Capital's position this year.

Northwest

Northwest Airlines reported a net profit of $2,116,180 and operating revenues of $71,363,494 last year, as compared with a 1954 profit of $2,415,524 and revenues of $63,595,851. Operations for 1955 were subsidy-free while Northwest received $3,035,000 in subsidy for 1954. Net income from property disposal was $88,861 last year and $212,380 in the previous year.

During 1955, Northwest flew 1,343,337 passengers 1,017,400,443 passenger-miles, an increase of 12% over 1954 traffic.

American

American Airlines increased revenues from $214,766,000 in 1954 to $260,756,000 last year. Net profit for 1955 was $18,609,000 as compared with $11,431,000 for 1954. Operating profit nearly doubled in the same period, going from $22,031,000 to $40,309,000.

Passenger traffic showed an increase of 24.3% to 7,319,000 passengers and 26.1% to 4,360,300,000 passenger-miles in 1955.

Freight traffic increased from 56,003,000 ton-miles in 1954 to 69,483,000 ton-miles last year.

Piedmont

Piedmont Aviation's airline division had revenues of $6,407,993 and a net operating income of $42,471 in 1955 as compared with income of $6,308,412 and $198,792 for the previous year of operations.

Addition of income from other divisions brings the total net income for the year to $97,445, down from $137,866 in 1954.

Piedmont carried 362,233 passengers during the year and 308,893 passengers the year before.

The carrier's load factors showed an increase from 47.51% in 1954 to 51.7% in 1955.

American, United Salary Reports

Washington—American Airlines and United Airlines have filed with the Civil Acronautics Board the following reports of officers' and directors' salaries for 1955:

American Airlines, C. R. Smith, president and director, $75,000 salary (up $1,815); William J. Hogan, senior vice president—finance, $55,000 salary (up $7,293); C. W. Jacob, senior vice president and secretary, $55,000 salary (up $7,293); O. M. Mosier, senior vice president—operations and director, $55,000 salary (up $7,293); C. R. Speers, senior vice president—sales, $44,315 salary (up $11,828); T. L. Boyd, vice president, $25,417 salary (up $417); G. J. Brandewiede, vice president, $32,500 salary (up $786); R. E. S. Dichler, vice president, $40,000 salary (up $968); L. E. Glasgow, vice president and controller, $28,105 salary (up $4,543); W. H. Johnson, Jr., vice president, $30,605 (up $4,187); P. W. Kayser, vice president, $21,250 salary; W. Littlewood, vice president, $29,052 salary (up $2,217); N. L. Smith, vice president, $10,807 salary; R. W. D. Smith, vice president, $31,552 salary (up $2,611); G. C. Van Nostrand, vice president, $29,052 salary; Marvin Whitlock, vice president, $26,552 salary (up $7,010); P. G. Larie, treasurer, $22,500 salary (up $794); M. G. Beard, assistant vice president, $22,500 salary; J. J. Casey, assistant vice president, $15,932 salary; T. F. Holden, assistant vice president, $13,834 salary; W. C. Lawrence, assistant vice president, $21,242 salary; J. B. Montgomery, assistant vice president, $14,861 salary; M. L. Rinehart, assistant vice president and assistant treasurer, $24,052 salary (up $1,969).

Also, E. O. Schroeder, assistant vice president, $24,052 salary; C. E. Taylor, assistant vice president, $14,917 salary; V. J. Long, assistant controller and assistant secretary, $20,000 salary (up $333); C. N. Oursler, assistant secretary, $13,930 salary; A. A. Paradis, assistant secretary, $13,621 salary (up $788); A. R. Bone, Jr., regional vice president, $21,969 salary (up $1,969); W. N. Bump, regional vice president, $24,678 salary (up $1,595); S. G. King, regional vice president, $24,052 salary (up $1,969); H. J. Lyall, regional vice president, $15,613 salary; M. D. Miller, regional vice president, $24,052 salary (up $1,969).

Also, Harold T. Ames, director, $900 directors fees; James W. Ashton, director, $900 directors fees (up $100); Harry E. Benedict, director, $1,000 directors fees (up $100); James Bruce, director, $900 directors fees (up $100); Edward H. Butler, director, $700 (up $400); Charles S. Cheston, director, $1,400 director fees (up $300); Thomas M. Conroy, director, $1,400 directors fees (up $300); John W. Farley, director, $900 directors fees (up $200); Charles T. Fisher, Jr., director, $1,000 directors fees (up $500); James A. Jackson, director, $1,000 directors fees (up $200); Robert W. Miller, director, $500 directors fees; Edgar M. Queeny, director, $700 directors fees (up $300).

Also, Alvord and Alvord, legal services, $12,000; Raymond E. Buck, legal service, $11,500; Covington & Burling, legal services, $282,500; Debevoise, Plimpton and McLean, legal services, $275,000; Kahn and Jacobs, architect service, $22,513; Naess and Murphy, architect service, $13,966; Skidmore, Owings and Merrill, architect service, $27,076; Arthur Young and Co., public accountants, $40,944.

United Airlines, W. A. Patterson, president, $100,000 salary (down $11,218.20); R. E. Johnson, vice president, $45,000 salary (up $475.92); J. A. Herlihy, vice president—maintenance and engineering, $46,000 salary (down $2,116.59); D. F. Magarell, vice president—transportation services, $45,000 salary (up $196.63); Ottis E. Kline, vice president—coordinator of operations, $45,000 salary (down $3,244.29); D. R. Petty, vice president—flight operations, $40,000 salary (down $171.59).

Also, Curtis Barkes, vice president—finance & property, $32,000 salary ($871.39); R. F. Ahrens, vice president—personnel, $30,000 salary (up $359.10); Hal E. Nourse, vice president—economic controls, $27,000 salary (down $1,773.45); R. W. Ireland, vice president—traffic administration, $27,000 salary ($3,052.35); S. P. Martin, secretary of corporation and assistant to president, $16,500 salary (down $341.23); R. E. Bruno, comptroller, $16,800 salary (down $37.73); A. M. De Voursey, treasurer and assistant secretary, $17,500 salary (up $505.67).

Also, Martin Ansorge, director, $3,250 salary (up $1,150); Paul A. Bissenger, director, $2,600 salary (up $1,252); H. Templeton Brown, director, $2,850 (up $750); Gardner Cowles, director, $2,850 salary (up $950); Justin W. Dart, director, $2,250 salary (up $700); Thomas F. Gleed, director, $1,602.78 (elected 6-30-55); Paul G. Hoffman, director, $2,750 salary (up $1,400); Eric A. Johnston, director, $2,500 salary (up $950); John J. Mitchell, director, $2,750 salary (up $900); Aksel Nelson, director, $2,452.78 (elected Feb. 23, 1955).

Also, Vernon Stouffer, director, $1,252.78 salary (elected June 30, 1955); Mayer, Freidlich, Spiess, Tierney, Brown & Platt, legal service, $261,990; Skidmore, Owings & Merrill, architect and engineering service, $11,595.65; John R. Steelman, consultation service, $11,000; Arthur Anderson and Co., audit service, $32,975; James Francis Reilly, Washington legal counsel, $30,500; Merryle Stanley Rukeyser, legal service, $11,000; Trippet, Newcomer, Yoakum and Thomas, legal fees, $12,160; Theiss, Olson, Mecklenburger, Von Holst and Coltman, legal fees on patents, $10,626; Holman, Nicklewait, Marion, Black and Perkins, legal service, $11,005; Rohrer, Hibler and Replogle, legal service, $12,000; Edwin Shields, Hewitt and Associates, consultation service, $20,234; Barrington Associates, management consultation service (sales department), $32,185.04; Raymond Loewy Associates, Inc., designing services, $110,946.85; Production Management Engineering Associates, Inc., engineering services, $16,831.25; H. J. Brunnier, engineering services, $11,299.36; Harriman Ripley and Co., agent fee in connection with debenture purchase, $180,000.

SIKORSKY S-55s will be Chicago Helicopter Line's first passenger carrier. Next year it hopes to have three 12-passenger S-58s.

HAS Plans to Carry Passengers in July

Chicago—Helicopter Air Service, Inc., has embarked on a three-fold expansion program to bring Chicago the first certificated downtown passenger helicopter service.

Anticipating full Civil Aeronautics Board approval of an examiner's recent recommendation that it be made the nation's third passenger helicopter line (AW Feb. 27, p. 100), the six-year old mail carrier already has:

- **Ordered three** new eight-place Sikorsky S-55s. Delivery at the rate of one a month begins in May.
- **Moved into** new quarters at Midway Airport with three times more hangar and office space.
- **Begun hiring** new personnel with plans to increase the payroll from 46 employes to 113 eventually.

C. W. (Wes) Moore, executive vice president, told AVIATION WEEK that HAS hopes for a final CAB decision on its passenger certificate by late May or June. If the certificate is granted HAS could start service between Midway and O'Hare Field by late July, he said.

Within 30 more days service could be extended from the two airports to the Loop in downtown Chicago. Arrangements already have been made for a heliport in Grant Park, near the Loop.

The first big step will be the operations transition from the mail-carrying Bell 47G to the Sikorsky S-55 (pilot and 7 passengers). HAS ordered three S-55s over a year ago, subject to final CAB approval of its bid for passenger service. Last month HAS withdrew the restriction and Sikorsky made firm delivery dates. HAS is paying $245,000 each for them, using local bank financing.

Transition From Bell 47Gs

HAS now is using six Bell 47Gs for its daily mail services. The helicopters pick up and deliver mail three times a day on each of four suburban routes, in addition to 18 round-trip shuttle flights between Midway Airport and the City Post Office (six-year operating statistics shown in table, p. 151). Beginning this summer the plan is to operate a mixed fleet of six helicopters—three 47Gs and the three S-55s. In another year HAS hopes to have three 12-passenger S-58s and would then operate a fleet consisting of three S-55s and three S-58s.

If passenger service is inaugurated with the S-55 it will begin as an all-daylight operation. By autumn, HAS expects to be geared for night operations. Passenger flights would operate constantly between airports and the Loop between 7 a.m. and 10 p.m.

Airport authorities, the airlines and the city have cooperated with HAS in its plans for the proposed passenger service. The passenger handling both at Midway and O'Hare would be at an American Airlines gate position, which means that boarding and deplaning could be accomplished next to the terminal.

Travel Time Cut

HAS estimates that travel time between the two airports and downtown Chicago would be cut by 80%. Midway is about 10 miles and O'Hare 19

C. W. MOORE

NYA-ALPA Contract

New York Airways and the Air Line Pilots Assn. have signed a new contract providing pay increases retroactive to Aug. 1, 1955. Other improvements gained for the pilots became effective on Feb. 17. The new ALPA-NYA contract is to run through Apr. 1, 1957.

Monthly helicopter pilot pay scales now in effect for an eight-year first pilot at half-day/half-night on New York Airways by type of aircraft are as follows: Bell 47, $921.20 for 80 hours and $956.90 for 85 hours; Sikorsky S-55, $957.20 for 80 hours and $995.15 for 85 hours; and Sikorsky S-58, $1,034.20 for 80 hours and $1,076.96 for 85 hours.

miles from the Loop, and ground transportation in heavy traffic takes about 45 minutes to reach either airport.

HAS has scheduled the S-55 for eight minutes between Midway and the Loop; 12 minutes from O'Hare to the Loop; and 12 minutes between O'Hare and Midway. Rates for the helicopter service are expected to be little more than taxi service costs now.

The question of passenger service to the suburbs still is unanswered. HAS has objected to the CAB examiner's recommendation that proposed suburban operations within a 75 miles radius of O'Hare be granted only on an exemption basis. In a formal protest, HAS told the Board that the exemption concept would cost it even its mail and property certificate for 302 miles of suburban routes which it has operated since 1949.

The Chicago Association of Commerce and Industry and the Illinois Department of Aeronautics also have taken exception to the examiner's report.

HAS has moved out of its old headquarters in the old American Airlines, airfreight hangar to completely take over the old TWA cargo hangar at Midway Airport. The new location has 24,000 sq. ft. of hangar space, with office space on a balcony. HAS has a 10-year lease, with an option for renewal and extensive renovating is planned.

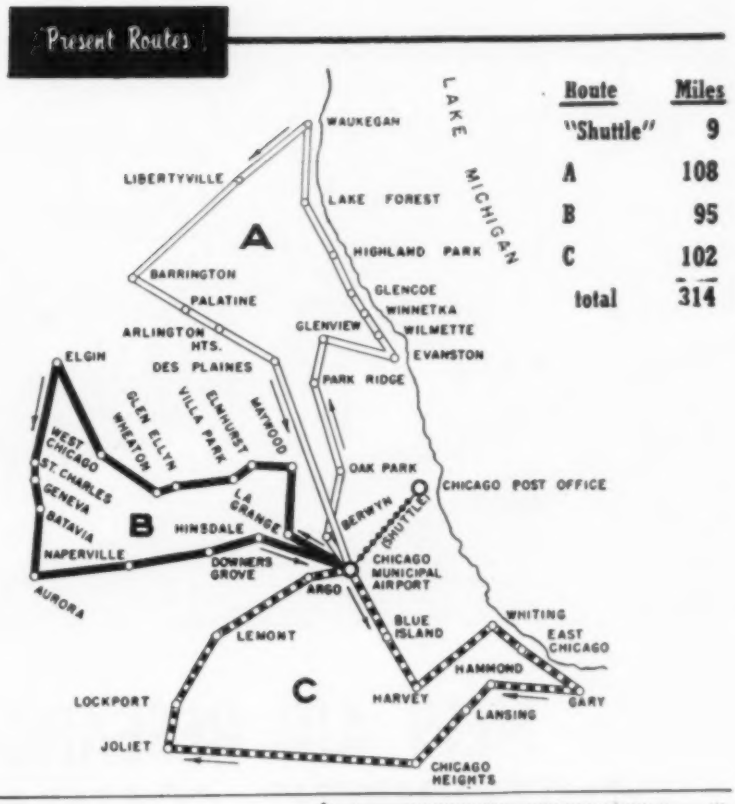
Three Pilots Are Executives

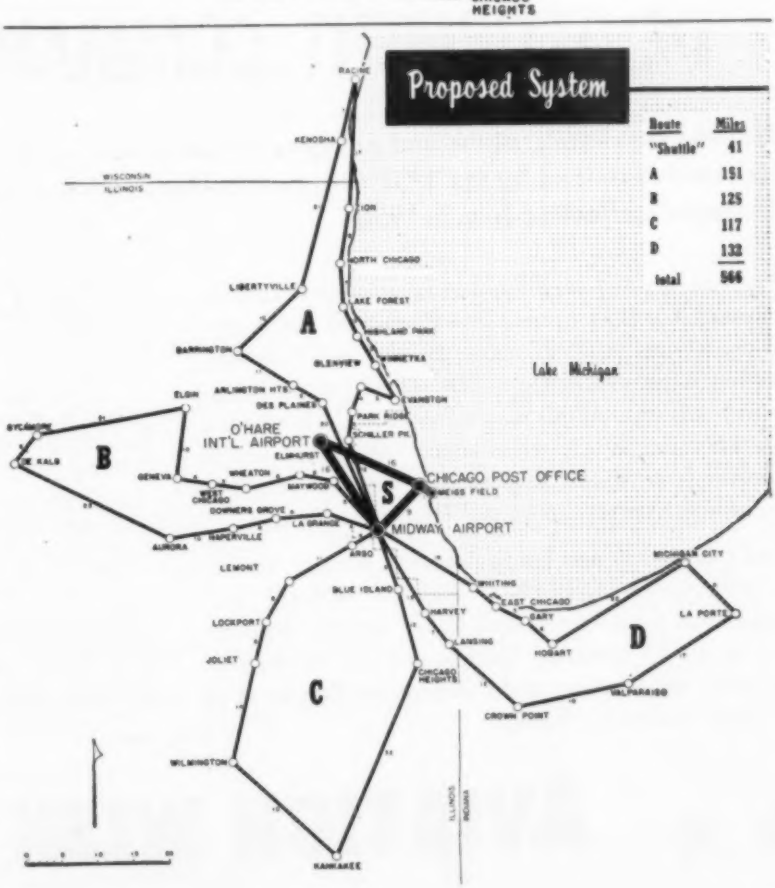
HAS now has 46 employes. It expects to have two and a half times that number if full passenger service gets underway. Most of the increase will come in the traffic and sales staff.

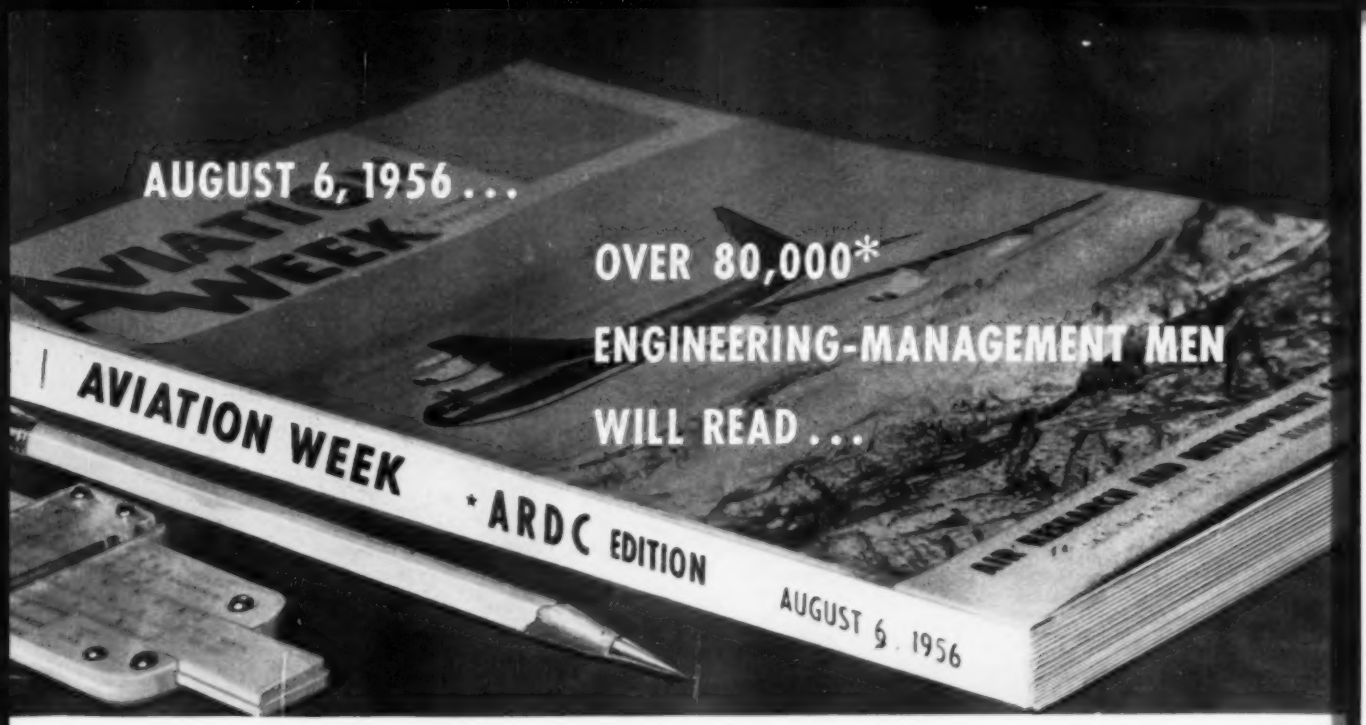
Eight of the company's 11 pilots are line of duty pilots. The others are former line pilots who have advanced to management. Moore, the executive vice president; Bob Angstadt, operations manager; and Ed Packer, chief pilot. The duty pilots' roster eventually will total 14.

HAS pilots recently joined the Air Line Pilots Assn. This means that all three certificated helicopter services now have been organized by ALPA. New York Airways has a new pilot contract (see box on p. 148). While Los Angeles Airways is organized, no contract has been signed.

The line pilots have an average of five years' service with HAS. All but one had prior helicopter time in the armed services—two with the Army, three with the Marines and one each from the Navy and Air Force. H. W. Symes, 32, who has flown more than 5,000 helicopter hours with HAS, is the company's highest-time pilot. H. K. Ryan, 34, has flown more than 3,000 hours with HAS and another 3,000 in Marine copters. Ray Vyskocil, 29, who has over 3,350 hours with







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AVIATION'S LARGEST MILITARY, ENGINEERING AND MANAGEMENT AUDIENCE WILL BE WAITING FOR THIS SECOND EXCLUSIVE ARDC ISSUE. BE SURE YOU ARE THERE!

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HAS Operating Statistics

	Dec. 1955	Dec. 1954	1955	1954	Total Operations 8–20–49 to 12–31–55
Pounds Carried:					
Shuttle	189,014	214,984	2,134,286	2,178,581	13,758,381
Route A	30,412	31,942	399,336	414,116	2,117,022
Route B	33,854	37,082	345,984	367,106	1,820,470
Route C	23,440	24,089	236,995	222,157	1,269,296
TOTAL	276,720	308,097	3,116,601	3,181,960	18,965,169
Hours Flown:					
Revenue	543:05	545:45	6,343:00	6,285:10	38,263:55
Non-Revenue	24:50	10:05	266:55	282:55	1,433:45
Non-Scheduled	.....	3:30	.....	578:00	1,281:10
TOTAL	567:55	559:20	6,609:55	7,146:05	40,978:50
Miles Flown:					
Scheduled	30,620	30,765	345,578	345,239	2,175,643
Flown	28,496	29,076	335,571	336,202	2,095,433
% of Performance	93.1	94.5	97.1	97.4	96.3
Ton-Miles Carried:	2,611.7	2,892.6	28,456.8	29,605.9	168,348.7

HAS, first joined the company as a mail handler. He left to fly co-pilot for Lake Central Airlines for a short time, rejoined HAS in 1952, and learned to fly helicopters.

Wes Moore joined HAS in February, 1949, six months before the start of scheduled mail service. His previous helicopter experience included a two-year stint in Argentina as chief pilot and operations manager for Tayar, a government-controlled company operating 13 Bell 47-B-3s in fighting a locust plague.

Bob Angstadt became HAS operations manager in 1953 after serving three years as chief pilot. He has returned to Chicago from a three-week visit to the Brussels headquarters of Sabena Belgian Airlines, where he checked out on Sabena's S-58 helicopter operation. The European helicopter operator had originally sent several representatives to observe HAS operations several years ago before beginning their own services.

Presently serving as HAS' chief pilot is Ed Packer, who joined the company in September, 1949. He has more than 5,000 hours as a helicopter pilot, with 4,000 at HAS. Packer has flown both the S-55 and S-58. He feels that the S-58 is a vehicle that will enable HAS to show a really first-rate helicopter passenger service.

Canadian Pacific Traffic Increased 45% in 1955

Participation in the cargo airlift along the arctic radar warning lines boosted Canadian Pacific Airlines domestic operations by 45% during 1955, resulting in a net profit of $969,000 for the year.

The airline's annual report issued by Canadian Pacific Railway, showed the airline carried 276,201 revenue passengers and nearly 24 million pounds of freight in 1955.

CPA has increased its order for Bristol Britannia turboprop airliners to five. The airline has an option on five more.

CAB Orders

(Apr. 5-Apr. 11)

GRANTED:

Allegheny Airlines authority to operate nonstop flights between Pittsburgh and Atlantic City from April 29 to May 31, 1956, and between June 1 and October 31 each year.

Riddle Airlines an exemption to lease one C-46 aircraft from Skyways Airlines Corp. for three months with a three-month renewal option.

Mohawk Airlines an exemption to buy seven Convair 240 aircraft with spares from Swiss Air Transport Co., Ltd.

Frontier Airlines authority to omit service at Flagstaff and Prescott, Ariz., on all flights in excess of three daily round trips between Winslow and Phoenix.

Mohawk Airlines authority to omit service at Pittsfield, Mass., on Segment 5 of Route 94 on flights in excess of one round trip daily from Nov. 1 to June 30 each year and flights in excess of one-and-a-half round trips daily from July 1 to October 31 each year. The authority terminates June 30, 1958.

Flying Tiger Line an exemption to perform one flight from Milwaukee to Cleveland for the Ford Motor Co.

APPROVED:

Agreement between various carriers adopted by the International Air Transport Assn. relating to special summer tourist fares on South Atlantic routes.

Agreements involving American Airlines, Continental Air Lines and various other carriers relating to various intercarrier arrangements.

Agreement between Flying Tiger Line and Trans-Caribbean Airways providing for the lease by Flying Tiger of one DC-4 from Trans-Caribbean.

ORDERED:

Applications of California Eastern Airways, Great Lakes Airlines and Trans American Airways in the Transcontinental Coach-type Service Case consolidated for further hearing with the Large Irregular Case. Air America's application in the case was dismissed.

Applications of North Central Airlines, City of Cedar Rapids, Iowa, and the Metropolitan Airport Authority of Rock Island, Ill., relating to service between the Quad Cities and the Twin Cities via Rochester and Cedar Rapids consolidated with the Quad Cities-Twin Cities Case. Motions for consolidation of other applications by North Central, the cities of Clinton and Dubuque and Western Air Lines were denied.

American Overseas Airlines, Trans World Airlines and Pan American World Airways' final mail rates for transatlantic operations between 1946 and 1953 adjusted for subsequent changes in the Internal Revenue Code.

Wien Alaska Airlines final mail rates set at 99.18 cents per mile for the period July 1, 1955, to Oct. 31, 1955; 151.23 cents between Nov. 1, 1955, and April 30, 1956, and the like six-month period in each succeeding years, and 99.18 cents between May 1, 1956, and Oct. 31, 1956 and the like six-month period in each succeeding year.

Resort Airlines added to the list of exempted carriers operating under contract with the Air Materiel Command.

DISMISSED:

Complaints of Air Freight Forwarders Assn. and Airborne Flower and Freight Traffic, Inc. against certain charges proposed by Slick Airways.

Investigations of Lake Central Airlines which became moot when the carrier was issued a permanent certificate.

Application for air service filed by the City of Salem, Ill., at the request of the applicant. **United Air Lines** shows cause order relating to inauguration of service at Ft. Dodge, Dubuque and Rockford, since the points have been eliminated from United's certificate.

Frontier Airlines' application for exemption authority to serve Grand Canyon, Ariz., since the issues have been consolidated in the Phoenix Service Case.

W. T. C. Air Freight's complaint against certain rates filed by Slick Airways.

DENIED:

Trans-Texas Airways' application for exemption authority to serve Ft. Worth as a terminal and Dallas as an intermediate point on Segment 9 of Route 82.

Trans-Texas Airways' application for exemption authority to extend its route from the terminal Lafayette, La., to New Orleans.

Board of Aviation Commissioners of Marion, Ind., permission to intervene in the Lima-Detroit Service Case.

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It costs next to nothing to take a few simple steps which may save hundreds of lives. Here they are. Check them off today.

☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

Act now . . . check off these four simple points . . . lives are at stake . . . have you a right to delay?

Airline Traffic—February 1956

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	535,304	319,144	**65.00**	1,603,032	822,998	4,432,118	38,246,310	**58.39**
Braniff	139,063	52,117	**60.97**	176,775	107,371	264,060	5,538,091	**54.03**
Capital	181,758	57,140	**57.64**	230,690	157,275	261,916	6,116,388	**43.37**
Colonial	27,961	7,020	**55.21**	13,600	5,856	28,145	718,485	**56.59**
Continental	50,052	17,931	**50.97**	62,309	24,095	95,646	1,900,925	**43.71**
Delta	174,144	84,688	**63.26**	289,571	201,906	542,773	9,188,052	**57.99**
Eastern	572,603	328,345	**64.84**	864,576	386,748	1,088,477	36,536,066	**51.91**
National	133,647	102,913	**71.81**	324,702	70,882	464,572	11,406,987	**71.26**
Northeast	35,673	7,129	**57.95**	10,228	12,000	16,280	700,826	**56.97**
Northwest	89,067	53,728	**54.81**	361,894	196,338	532,851	6,463,825	**49.63**
Trans World	277,729	202,255	**56.52**	1,023,895	628,545	1,796,092	22,843,612	**53.02**
United	432,583	277,141	**61.25**	2,221,029	951,594	3,023,720	32,813,778	**55.46**
Western	399	102	**66.23**	.....	.....	.....	9,650	**56.49**
INTERNATIONAL								
American	11,199	8,581	**80.11**	11,541	210	235,294	1,171,207	**79.93**
Braniff	2,581	5,377	**44.57**	21,480	.....	69,950	700,911	**47.26**
Caribbean Atlantic	17,290	1,349	**60.21**	1,104	.....	3,086	127,862	**57.69**
Colonial	1,259	976	**37.42**	508	.....	2,151	109,295	**41.00**
Delta	4,995	4,863	**56.49**	7,592	.....	60,484	566,360	**47.08**
Eastern	14,947	20,506	**62.25**	72,456	.....	72,494	2,376,864	**56.10**
National	12,217	7,447	**73.19**	8,608	3,330	18,141	805,038	**71.65**
Northwest	6,180	12,923	**49.15**	884,347	18,948	617,107	2,935,477	**64.79**
Pan American								
Alaska	4,037	5,008	**58.76**	29,048	.....	224,392	784,457	**47.50**
Atlantic	53,408	64,564	**54.94**	947,527	.....	1,814,868	9,616,462	**57.40**
Pacific	17,648	52,148	**65.70**	1,053,284	.....	1,247,027	7,897,103	**65.82**
Latin America	100,071	80,002	**64.63**	312,536	.....	2,872,853	11,282,969	**62.69**
Panagra	11,291	13,806	**61.33**	47,726	.....	268,019	1,781,871	**99.70**
Trans World	11,687	29,650	**51.63**	698,844	.....	680,148	4,604,144	**66.01**
United	5,821	14,490	**62.63**	93,218	.....	43,874	1,644,792	**59.37**
LOCAL SERVICE								
Allegheny	22,395	3,570	**42.04**	5,709	13,996	641	359,427	**42.71**
Bonanza	10,273	2,817	**41.49**	4,045	3,255	3,689	218,981	**39.94**
Central	6,488	1,209	**29.42**	3,015	2,757	3,895	125,287	**26.67**
Frontier	15,218	4,867	**54.82**	21,480	9,142	42,117	537,994	**63.62**
Lake Central	8,401	1,292	**34.16**	1,685	10,653	.....	132,512	**32.21**
Mohawk	22,578	4,021	**55.22**	3,803	5,620	7,709	400,325	**54.97**
North Central	34,753	5,239	**47.61**	16,849	24,193	.....	541,317	**43.12**
Ozark	19,179	2,895	**33.29**	6,829	11,773	.....	289,426	**33.76**
Piedmont	24,485	4,656	**44.39**	13,032	9,769	8,803	476,935	**44.82**
Southern	12,414	2,141	**40.26**	7,393	10,237	.....	222,614	**38.63**
Southwest	18,738	3,740	**43.21**	7,200	4,670	13,286	381,423	**43.35**
Trans Texas	14,060	3,179	**37.17**	11,220	6,722	14,258	335,233	**34.29**
West Coast	14,186	2,576	**41.56**	3,753	.....	1,970	252,088	**50.00**
HAWAIIAN								
Hawaiian	25,376	3,574	**56.90**	3,515	.....	112,734	400,876	**48.48**
Trans Pacific	11,357	1,437	**45.94**	929	.....	6,962	120,529	**46.82**
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	.....	.....	650,777	650,777	**60.15**
Flying Tiger	3,478	10,527	**94.90**	22,034	.....	5,360,909	6,435,721	**69.57**
Slick	1,586	3,321	**72.53**	35,065	.....	4,922,760	5,289,883	**75.31**
Riddle	.....	.....	.....	.....	15,918	1,548,520	1,564,438	**87.22**
HELICOPTER								
New York Airways	2,147	41	**51.90**	819	1,083	399	6,052	**55.65**
Los Angeles Airways	1,095	45	**41.66**	4,470	1,673	.....	10,257	**47.40**
Helicopter Air Service	.....	.....	.....	2,161	.....	.....	2,161	**46.96**

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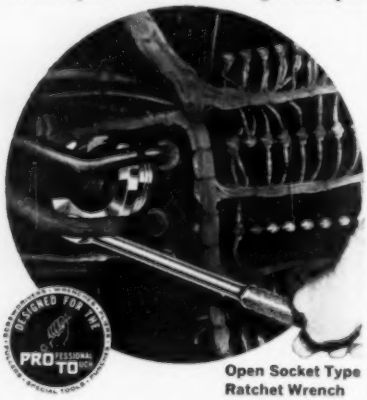

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Magic for those Hard-to-Reach Places!

Yes... PROTO has acquired the complete line of TAC ratcheting wrenches and is now the sole manufacturer of these patented, versatile tools.

Using the open-end ratcheting principle, these wrenches work in close quarters, over and around tubing, on hidden bolts and nuts, in recesses or wells. See your PROTO dealer. Send 10¢ for catalog of entire line to

PROTO TOOLS
2213 Santa Fe Ave., Los Angeles 54, Cal.
Eastern Factory, Jamestown, N.Y.
Canadian Factory, London, Ont.

Closed Socket Type
Ratchet Wrench
⅜"—1-1/16" Openings

Crowfoot Type
Ratchet Wrench
⅜"—3" Openings

In addition to the three types of ratchet wrenches shown above, the PROTO-TAC line includes ratcheting box wrenches, screwdriver attachments, rigid heads, and adapters for turnbuckles, standard sockets and internal wrenching.

9884

PROTO TAC TOOLS
PROTO means PROfessional TOols

COCKPIT VIEWPOINT

By Capt. R. C. Robson

Trapped in the Approach-Light Bog

Despite the emphasis aviation has placed upon standardization, few items show greater diversification than approach lights. Theoretically, the U. S. has a standard, but, more correctly, it is a triple standard, providing for Configurations A, B and C. Actually, there are over a dozen "systems" in use, including modifications of each standard, left-overs from yesteryear, special tailor-made jobs and plain "we give up, what is it?" varieties.

Would you believe that a pilot could land at a dozen airports and find as many sets of lights? Here are some:

Washington National	Slopeline.
Baltimore	Left hand row incandescent hi-intensity.
Newark	Configuration A (ATA and ALPA's only preference) centerline bars of incandescent hi-intensity plus condenser discharge units.
LaGuardia	Left hand row, part incandescent hi-intensity, part neon bars.
Pittsburgh	Configuration B and using 800 feet of active runway.
Cleveland	Local variety—condenser discharge lights in single row 25 feet off centerline plus few neon bars in left hand row.
Chicago Midway	1,200 feet left hand row incandescent hi-intensity bars.
Chicago O'Hare	Partial, or modified Configuration B (no single row extension).

Committed Decision

What I can see through my windshield is crucial in the final stages of an approach for I must act as an instantaneous computer, translating the information I see into aircraft response in a matter of seconds. Because of the pressure for rapid action, there is a tendency to make a "committed decision" upon the first information received. Unless this information is correct and presented in a straightforward, "pre-digested" manner, the result may mean trouble. Here are some of the problems.

Many systems do not give enough light, so I cannot see them soon enough. Stub rows, such as Configuration B, are too short to give me adequate definition of track. Unless condenser discharge units are used, the only picture may be that of a large diffused glob of light containing no direction information.

Any system containing multiple rows is bad. I may mistake them for runway lights. Unless a centerline leads directly to the landing area, I may never find the runway. A left hand row (when I'm exactly "on" localizer) gives the impression that I am flying a converging course with the lights and urges me to turn right—the wrong maneuver.

Visual Needs

For visual flight in the approach zone I need certain things: Identification, alignment information, roll guidance, height guidance, distance, positive threshold identification. The only system which provides me with these factors in a proven, acceptable form is Configuration A—the centerline system.

Theories have been advanced about cockpit cutoff angles, clear over-run areas, red filters to eliminate blindness and such things. But if we eliminate approach lights from a space 1,000 feet prior to the runway or install left hand or multi row systems for cockpit cutoff, then we have built an effective airport cutoff. Landings at such fields under very low conditions will be hazardous.

(A second column on the inadequacy of U. S. approach-light systems will appear next week.)

Now—

from the makers of precision aircraft switches . . .

with

- **LONGER LIFE**
  (150,000 operations, elec. and mech.)
- **DIRECT INTERCHANGEABILITY**
  (Meets AN 3234 Specifications)
- **ACCURATE REPEATABILITY**
- **LOW COST**

SERIES F2 BASIC SWITCH
F2-3: Single Pole, Double Throw
F2-2: Single Pole, Normally Open
F2-1: Single Pole, Normally Closed

The new Electro-Snap F2 Series snap action switches are extra-compact with extremely high electrical capacity for their size. Mechanical and electrical life at 1/32″ overtravel is 150,000 operations, minimum, with accurate repeatability and constant stability of tolerances. Self-aligning springs provide contact wiping action rare in a switch of this size.

Write for Data Sheet **FM4.**

Durable case of special plastic gives the switch an ambient temperature rating of −100° to +275° F.* Available, *at low cost,* in three basic models with a wide selection of actuators.

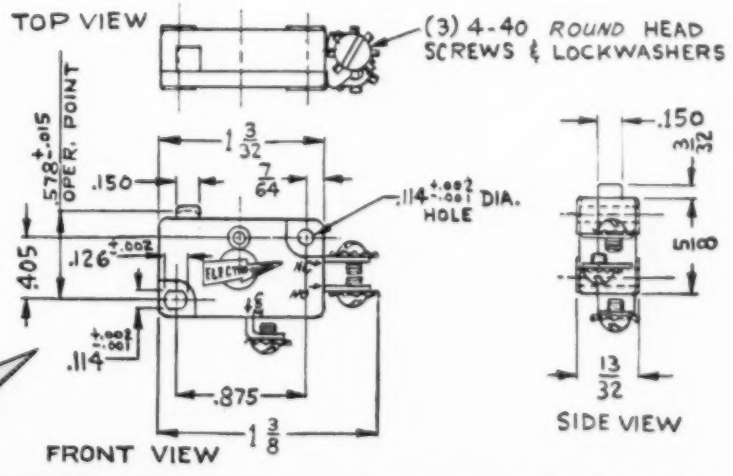
*Available with −100° +350° rating

ELECTRO-SNAP
SWITCH AND MFG. CO.
4232 West Lake Street, Chicago 24, Illinois

OPERATING CHARACTERISTICS

Electrical Rating:
10 AMPS; IND. + RES.
30 V.D.C. 110/250 V.A.C.
(RATING FOR AIRBORNE APPLICATION;
6 AMP 30 V.D.C. INDUC.)

Operating Force	7 to 12 oz.
Reset Force	4 oz. Min.
Pretravel	3/64 Max.
Movement Differential	.011 ± .005
Overtravel	1/32 Min.

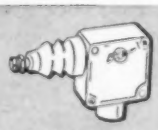


ELECTRO SNAP

MODERN DESIGN IN A COMPLETE LINE OF SWITCHES

SUB-MINIATURE SWITCH

DOUBLE-POLE SWITCH


ONE-WAY LIMIT SWITCH

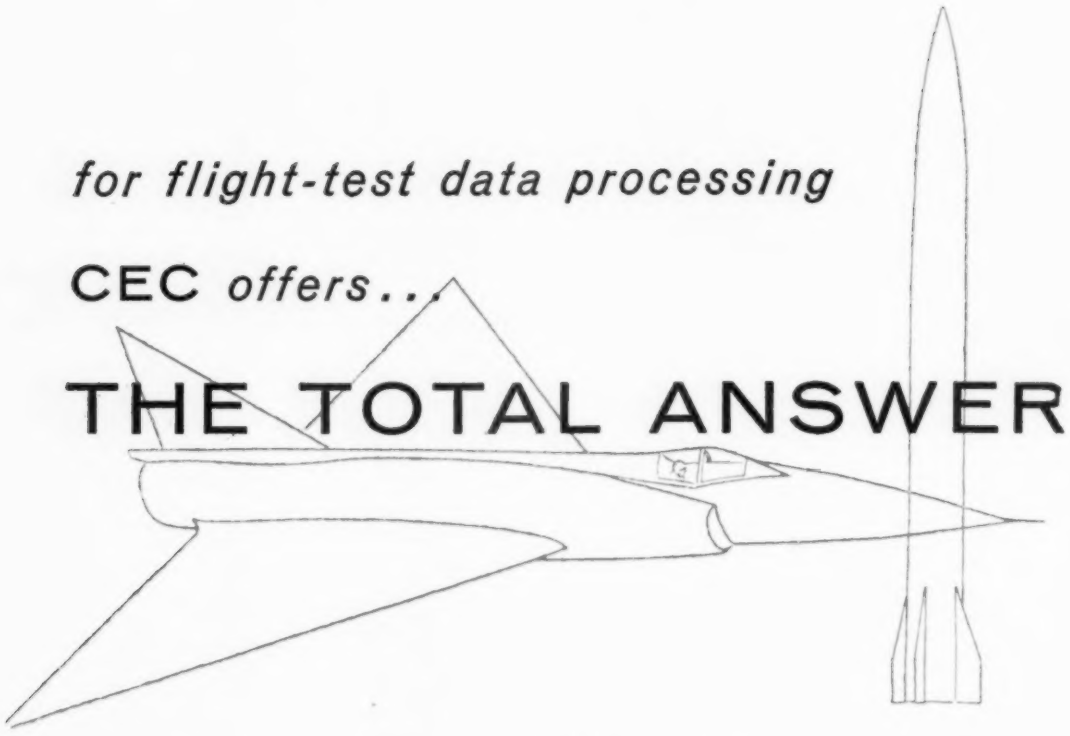
IMMERSION-PROOF SWITCH

HERMETICALLY-SEALED LIMIT SWITCHES

for flight-test data processing

CEC *offers . . .*

THE TOTAL ANSWER



It's time somebody said it: *magnetic-tape equipment by itself is not the whole answer!* That's why Consolidated Electrodynamics . . . while it offers the most advanced and complete line of magnetic-tape flight-test instrumentation . . . is stressing this policy:

"We're selling *Data Processing*, not components alone."

Since a single test flight of today's intercontinental bomber involves about 1½ million data points, quick and complete solutions to the enormous problems of data processing are imperative. Faster and more accurate data processing reduces design time and means better planes in the air . . . *sooner.*

Consolidated Electrodynamics, following its policy of selling the "Total Answer" to your problems, offers equipment literally covering the span from phenomena to digits. Whether your requirements can be satisfied by standard units or your test objectives demand development of special equipment, CEC will work in any of three general brackets . . .

1st . . . **STANDARD COMPONENTS** of the comprehensive CEC DataTape line, all designed specifically for flight-test work. Shown on the opposite page, the DataTape line includes recorders and record amplifiers, as well as supporting units such as signal modulators and coders, range-time generators, automatic calibrators, and complete ground-playback and demodulating equipment. (Standard equipment of other manufacturers can also be supplied when needed to complete a data-processing system.)

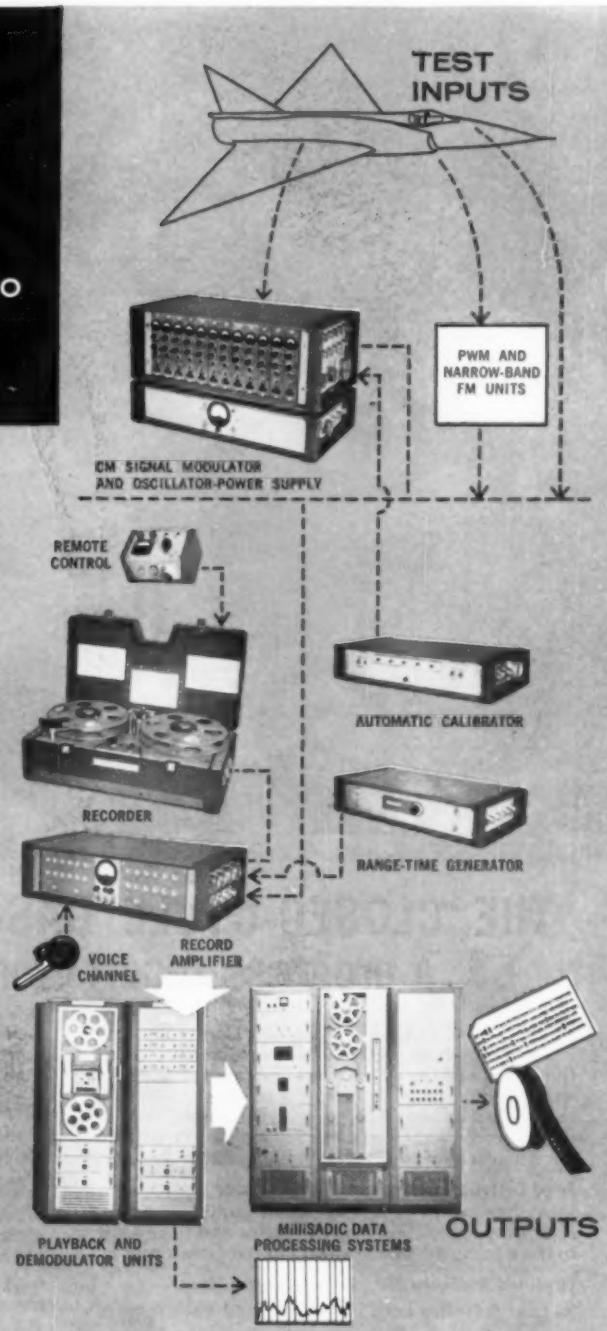
2nd . . . **SEMI-STANDARDIZED SYSTEMS** (designed by CEC's Systems Division) of magnetic-tape data-processing systems, each designed to solve a specific set of test problems but easily modified to cover unique problems arising from new vehicle designs, new parameters, new test objectives.

3rd . . . **RESEARCH AND DEVELOPMENT** (through Consolidated's new Advanced Electronics Data Laboratory) for those cases where present equipment of CEC's own manufacture or that of other companies will not adequately accomplish the test mission or the type of data processing necessary.

Phase 2 of "Operation Data," Consolidated's famous mobile show trailer which travelled over 23,000 miles in 1955, will be in your area soon. Phase 2 will feature a complete display of DataTape and the companion automatic equipment with which CEC is helping America's aircraft and missile designers break the flight-test bottleneck. Watch for it soon!

"Test Variables to Digits"

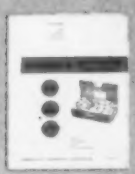
. . . Consolidated's answer to flight-test bottlenecks



Consolidated's long-standing leadership in flight-test instrumentation includes the pioneering of the "systems" approach—the designing of instrumentation for the *Total Answer* rather than just components. "Test Variables to Digits" is literally true as a description of CEC's products and experience.

From CEC's Transducer Division have come some of today's most widely used devices for *sensing* the parameters of supersonic flight. DataTape, shown at the right, was developed specifically for the problems of flight-test data *handling*, is a coordinated family of instruments ready to serve as a proven nucleus for a wide variety of data-processing systems. For the vital step of *digitizing* test data, CEC developed the SADIC and MilliSADIC group of instruments and systems—today's most comprehensive, *proven* line of analog-to-digital data-processing units.

The Consolidated Systems Division is ready to add to these basic units whatever output devices are needed to accomplish the test mission. These range from CEC's own MilliSADIC, ground playback and demodulator units, and recording oscillographs to the equipment of other manufacturers, such as oscilloscopes, spectrum analyzers, and chart recorders.



For the Total Answer to your data-processing problems . . . whether in connection with today's or tomorrow's aircraft and missiles . . . it will pay you to call in the experienced engineers of Consolidated Electrodynamics. There's no obligation. And for the story of DataTape, send today for Bulletin 1561-X11.

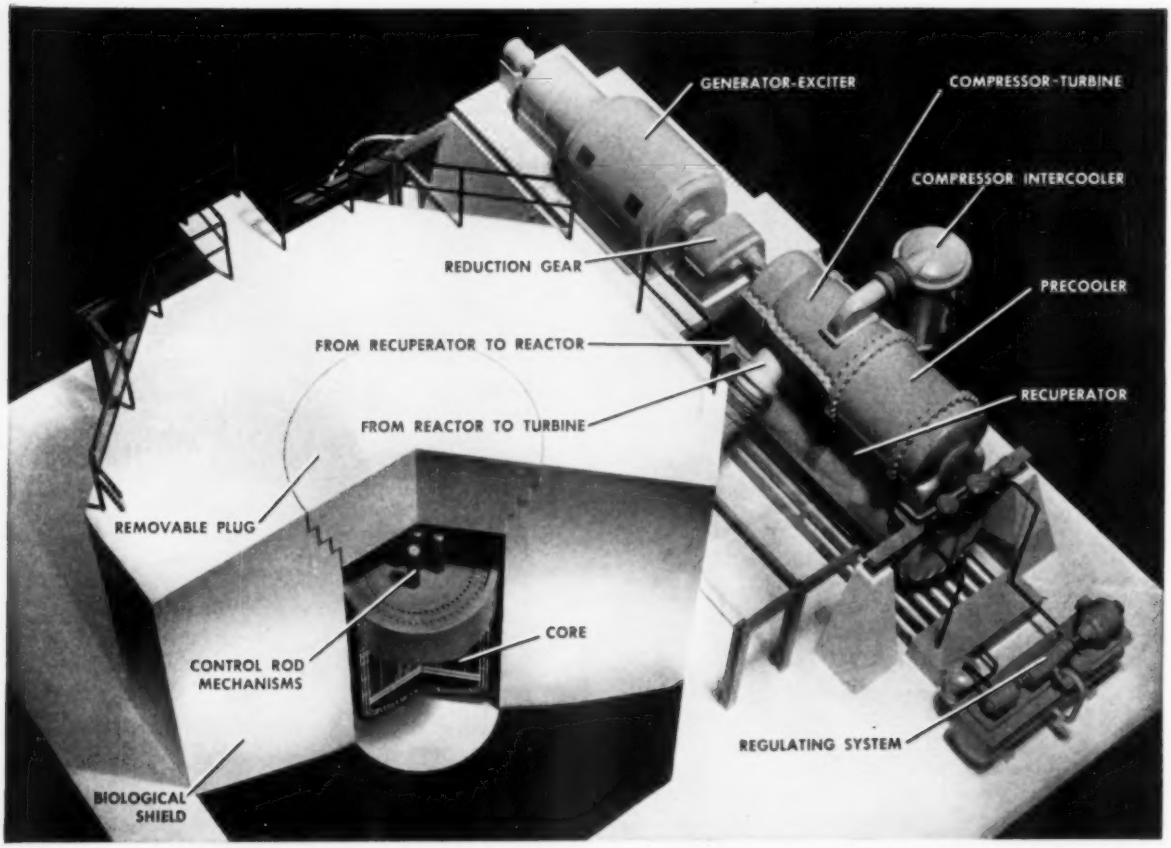
Consolidated Electrodynamics Corporation

formerly Consolidated Engineering Corporation

ELECTRONIC INSTRUMENTS FOR MEASUREMENT AND CONTROL

300 North Sierra Madre Villa, Pasadena, California

Sales and Service Offices in: Albuquerque, Atlanta, Boston, Buffalo, Chicago, Dallas, Detroit, New York, Pasadena, Philadelphia, San Francisco, Seattle, Washington, D. C.



Model of a closed-cycle gas-cooled reactor power plant designed by Ford Instrument in conjunction with American Turbine Company.

THE CLOSED-CYCLE GAS-COOLED REACTOR
. . . a progress report from Ford Instrument

What Is It? The Closed-Cycle Gas-Cooled Reactor is a reactor whose principle of operation is based on the concept of the use of a gas under pressure as the working fluid for *direct* transfer of energy from the reactor to a turbine. The gas used is nitrogen, carbon dioxide or helium. The closest analogous commonly known reactor type is the "boiling water" reactor.

Ford Instrument Company's Position: Ford Instrument has been conducting studies into the nature and prospects of this type of reactor and believes it to have many advantages as a nuclear power source.

Findings Indicate This Reactor Type Has:

1. *Low* cost—for both installation and kw-h output.

2. *High* thermal efficiency, with efficiency relatively independent of level of power output; i.e., high efficiency at part load.

3. *High* power capacity. The study indicates that power capacity can be over 200 megawatts (output) from a single unit.

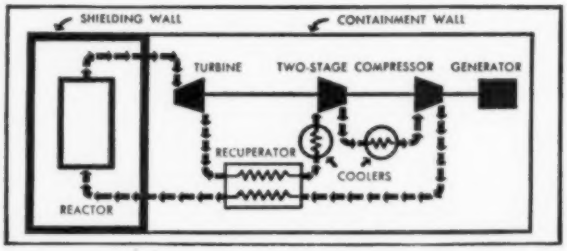
4. *Extreme* simplicity of operation.

5. *Maximum* safety. The nature of the working fluid used, with its freedom from phase change, means that provisions for containment in the event of an "incident" are simple, and that protection against incidents is simultaneously enhanced. The closed-cycle design precludes contamination of the atmosphere.

6. *A minimum* of moving parts. In this design, pumping power is provided by a turbo-compressor set, and no other pumps are required.

For more information on this new type of reactor write Ford Instrument Company.

A SCHEMATIC OF THE CLOSED-CYCLE GAS-COOLED REACTOR



101

FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Ave., Long Island City 1, N. Y.

FOR SPATIAL REFERENCE

Gyros

BY Greenleaf

QUALITY ABOVE ALL!

HIG-4, Model 2 GYRO, Now Available!

DATA

1. Spin Motor: 12 Volts A.C., 400 cps, 2 phase
2. Power Required: Running 1.5 Watts—Start 2.2 Watts
3. Run-up Time: 15 Seconds Maximum
4. Angular Momentum: 10^4 Gram-Centimeter^2/second
5. Gimbal Travel: ± 5° Maximum
6. Signal Generator Sensitivity: 10 mv/mr, with 55 m/a, 400 cps
7. Signal Generator Linearity Deviation: ± 1%
8. Torque Generator Linearity Deviation: Less than 1%
9. Input Rate: 4 Radians/second Maximum
10. Drift Rate: .005 milliradian/second
11. Weight: 1.5 pounds

NOTE: *This Gyro can be readily modified to meet your requirements. We invite inquiries listing specifications.*

The Greenleaf Line of Gyros and associated devices is being steadily expanded. It now includes a wide selection of Free and Rate Gyros, and the HIG-3 and HIG-4 Gyros.

Write, wire or phone for further information.

ENGINEERING · DEVELOPMENT · PRODUCTION

THE Greenleaf MANUFACTURING COMPANY

7814 W. Maplewood Industrial Court • Saint Louis 17, Missouri

Producers of the HIG-3 and HIG-4 Gyros, Rate and Free Gyros, Differential Pressure Mach Meters, Air Speed Indicators, Computers, Switches and many other precision-built components.

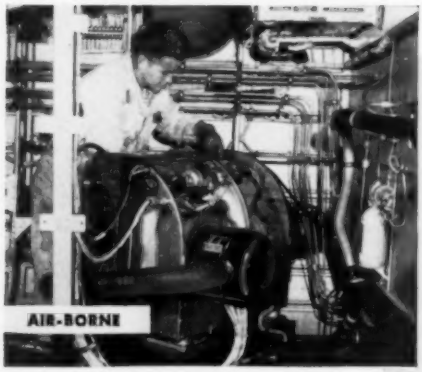
At Greenleaf Plant No. 2 facilities are available for precision castings.

ENGINEERS WANTED

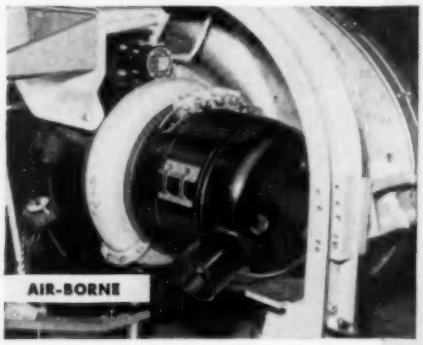
Greenleaf offers unusual opportunities for mechanical and electrical engineers

GRE-51

14,000 J&H Generators



On the Douglas C-124C *Globemaster*, Solar Aircraft Company "Mars" APU's, using G32 machines, have logged more than 40,000 hours with overhauls scheduled at 750 hours.



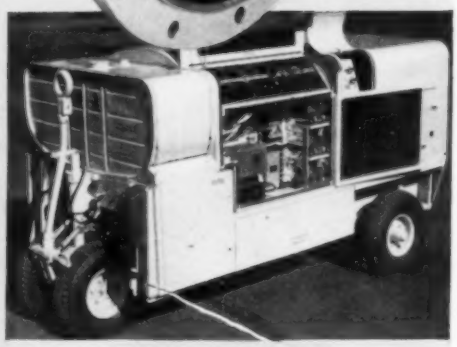
Pod-hung "Mars" APU's by Solar provide a-c and d-c power for the testing of advanced electronic gear aboard the Convair C-131B "Flying Laboratory."

J&H Generators are easily identified in this view of the MD-3 Ground Power Unit assembly line at Consolidated Diesel Electric Corporation.

J&H Model G32 d-c Generator.

GROUND

USAF type MD-3 GPU's (right) for aircraft starting, ground test and servicing use three G32-3's. They are manufactured by Beech Aircraft Corporation and Consolidated.



SHIPBOARD

An important G32 application may be seen on any Navy carrier deck. Self-propelled "Jeep" type mobile power units (below), manufactured by O. E. Szekely & Associates, provide fast starting for getting Navy fighters in the air.

JACK & HEINTZ *Rotomotive*

in APU field service!

Designed specifically for auxiliary power application, the G32 Generator has been up-rated from 500 to 750 amps continuous

HIGHER OUTPUT: The G32 delivers 750 amperes continuously—at least 50 per cent more power than similar contemporary machines. This generator has excellent overload characteristics such as required in jet starting application.

SIMPLER, LIGHTER INSTALLATIONS: High power of the G32 permits reducing the number of generators in many APU installations. Simultaneously, the complexity of associated components is simplified with resulting weight savings—a significant factor on air-borne applications.

WIDE FIELD EXPERIENCE: More than 14,000 J&H G32 Generators are in the field today! Their use includes air-borne, shipboard and ground-power installations where 600 to 750-amp, continuous-duty conditions exist. Service records show longer periods between overhauls, reduced maintenance costs.

STARTER-GENERATORS: Two of the J & H Series Generators act in a dual role . . . are supplied with a starter winding which enables the generator to act as a starter for gas turbine engines on many APU's.

COOLING: Both blast-cooled and self-cooled models are available.

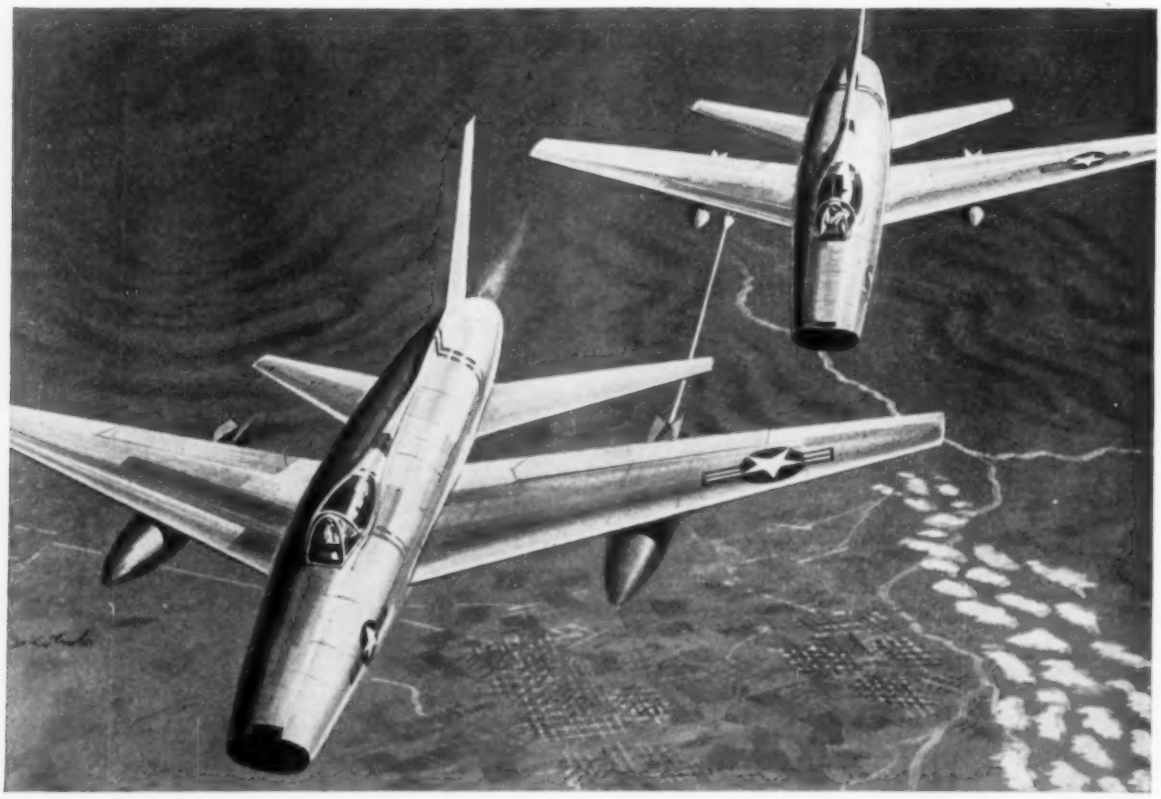
JACK & HEINTZ G32 D-C GENERATORS

(a-c generators also available in ratings through 160 kva)

J & H MODEL NUMBER	G32-3	G32-6 Starter-Generator	G32-8	G32-9	G32-10 Starter-Generator
Continuous-Duty Rating					
Speed (thousand rpm)	4-8	4-8	4-8	4-8	4-8
Voltage	30	30	30	30	30
Amperes	750	750	750	750	750
Intermittent Rating (amp)	1000+	1000+	1000+	1000+	1000+
Cooling Method	Blast cooled	Blast cooled	Self cooled	Blast cooled	Self cooled
CFM of Air at 6" H_2O	300	300	—	300	—
Weight (lb)	78	79	82	78	83
Overhung Moment (in.-lb)	385	406	430	385	450
Over-All Length From Mounting Flange (inches)					
Radial Air Inlet	13	13	—	13	—
Axial Air Inlet	—	14	—	—	—
Self-Cooled	—	—	13	—	13
Diameter (inches)	10	10	10	10	10
Flange-Type Spline AND 10266	XV1H	XV1H	XV1A	XV1H	XV1A
Rotation (viewed from end opposite flange)	CW	CW	CW	CCW	CW

For complete information on J&H G32 d-c Generators for auxiliary power units, write: Jack & Heintz, Inc., 17635 Broadway, Cleveland 1, Ohio. Export Department: 13 East 40th Street, New York 16, New York.

© 1956 by Jack & Heintz, Inc.



RANGE EXTENDED on F-100 Super Sabres with FLIGHT REFUELING "buddy" system

A quickly installable refueling system, now being developed for North American Aviation, Inc., by Flight Refueling, Inc., will permit fast conversion of the North American F-100 Super Sabre fighter into an aerial tanker to give other F-100 "buddies" far-ranging striking power.

Operating in pairs—one refueling, one striking—the F-100 of the Tactical Air Command becomes an even more potent weapon, adding greatly extended range to its supersonic capability.

To develop a compact, high capacity refueling system, it was natural for North American Aviation to turn to Flight Refueling, Inc. The Flight Refueling organization pioneered in aerial refueling equipment. Its Probe and Drogue refueling system has been standardized by the U. S. Navy and by TAC for the KB-50 multiple-point tanker program.

Today, FRI is working on a number of other projects in conjunction with major airframe manufacturers to develop aerial refueling systems for their equipment. More than ever, FRI's new manufacturing facility at Baltimore can truly be known as *"headquarters for Range Unlimited."*

ATTENTION
ENGINEERS

Fascinating, new projects to develop new long-range flight systems present unusual career opportunities for engineering personnel. Write Engineering Manager for further details.

Flight Refueling, Inc.

FRIENDSHIP INTERNATIONAL AIRPORT
Baltimore 3, Maryland

Well on the way with AMWELD®

AIRCRAFT COMPONENTS

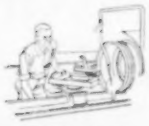
The process of manufacturing today's super power jet aircraft engines is the assembling of the finest engineering and production skills into a masterpiece of American ingenuity.

The prime contractor must be concerned with the ability of hundreds of sub-contractors to produce components to the rigid quality demanded by aircraft specifications.

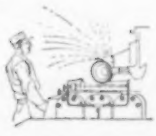
American Welding supplies welded rings and components to major U. S. jet engine manufacturers.

Let Amweld's Industrial Products Division study your problem in circular welded components. Better yet, send us your blueprints and then your production can be "well on its way with Amweld."

WELDING



FABRICATING



MACHINING

THE AMERICAN WELDING & MANUFACTURING CO.
420 Dietz Road • Warren, Ohio

AMERICAN WELDING

THE ERA OF THE ELAND

The 'Lion' of the turbo-props

1956-1966 will be the era of the Eland. For at least those ten years the Napier ELAND will lead the turbo-props, just as the old Napier LION led the piston-engines of its day. A confident claim? Yes—but it's justified by facts. Here are the facts:

We made the right basic decision

From the first we decided on a single-spool turbo-prop. The advantages over a twin-spool were always obvious: lower weight with greater simplicity, flexibility, safety and economy. Yet it was an all-or-nothing decision, for everything depended on the compressor. We were sure we could make the compressor we needed, and events have proved us right. The compressor of the Eland has the highest stage-loading of any in the world.

We did the right basic research

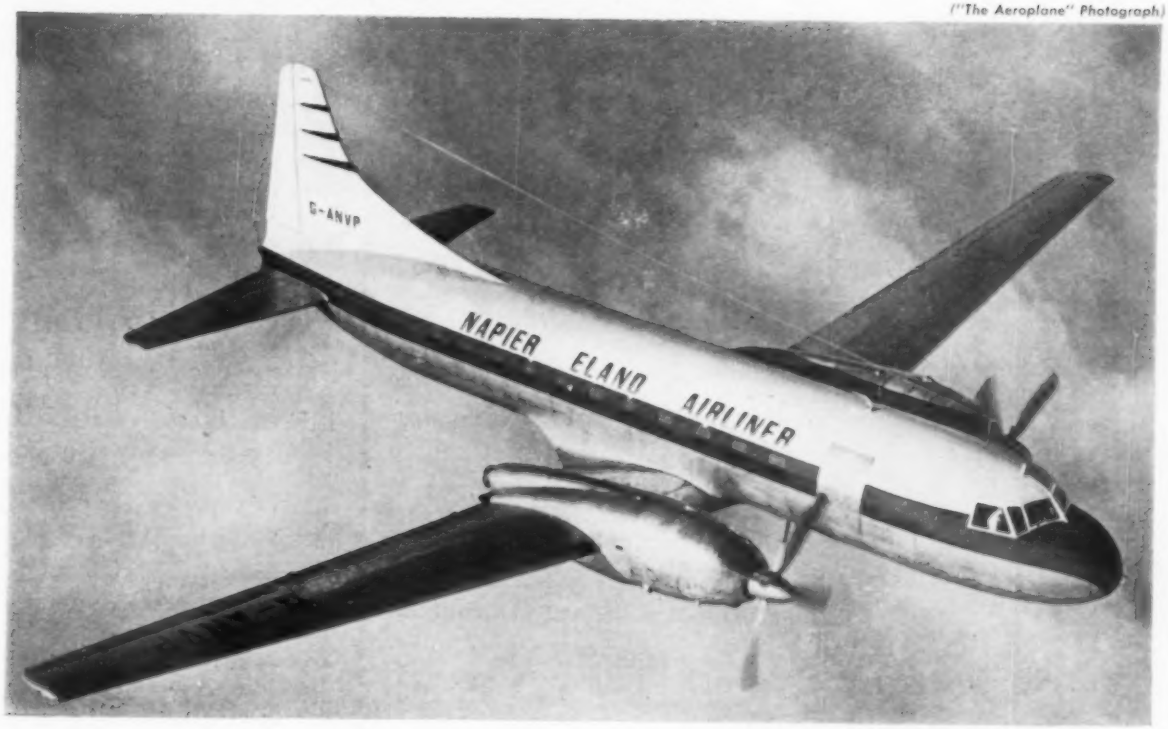
We decided early on to go right back to fundamentals. So, in 1947, at Liverpool, we built the largest gas turbine research station in Europe. In it we have done 8 years' continuous work on compressor and turbine design techniques. In it we have developed a unique engine control system which guarantees that the Eland turbines will never have to meet higher temperatures than they have already met for thousands of hours on test-bed and in the air. The performance and safety and flexibility of the Eland rest upon sure foundations.

The right engine at the right moment

Medium-haul airlines all over the world are faced with the problem of changing over to turbo-props in the 3,000-4,000 e.h.p. range. Elands are the imaginative, *and the safe*, answer. Because of its simplicity the Eland is inherently safe—*and* economical to run and service. Because of its flexibility it is adaptable to any and every operating condition. These qualities, plus small diameter and excellent power-weight ratio, make the Eland a good engine both for new aircraft and for conversion projects.

IS BEGINNING . . .

("The Aeroplane" Photograph)



NAPIER ELAND AIRLINER — an American Convair-Liner 340 which we have bought from the makers and converted from piston-engines to Napier Eland turbo-props. With the increased—but quieter—take-off power available, the aircraft can operate at an all-up weight of 53,200 lbs. instead of 47,000 lbs. and can carry its maximum payload of 12,880 lbs. over the much greater stage distance of 1,220 miles instead of 290 for the piston-engined version. The cruising speed is increased by 45 m.p.h. Apart from the change of engines, modifications have been kept to a minimum.

The Napier Eland Airliner will be flown on route proving trials and demonstration tours in Europe and the U.S.A.

In this Anglo-American enterprise we are not only demonstrating our confidence in the engine; we are also offering to the world's many Convair operators a simple way of giving new life, increased revenue and greater passenger appeal to their aircraft—by changing to Eland turbo-props.

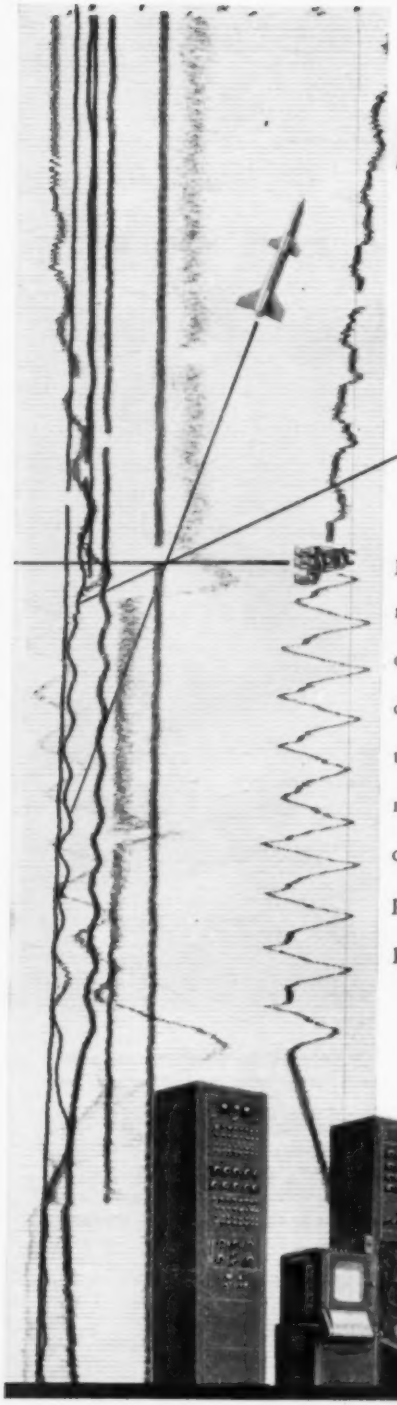
Still higher powers to come

The Eland is years in the lead—and we are not sitting back and watching that lead melt away. We are applying what we have learned to the development of still higher powers—keeping the Eland always ahead of its time. The Era of the Eland is only just beginning!

HOW ARE YOU GOING TO USE THE ELAND TO *YOUR* ADVANTAGE?

J. C. K. SHIPP, Group Aviation Representative
Suite 223, Dupont Circle Building,
1346 Connecticut Avenue N. W
Washington 6 D. C. Telephone: Dupont 7-2123

D. NAPIER AND SON LIMITED LONDON W. 3. ENGLAND
Partners in Progress with THE ENGLISH ELECTRIC COMPANY LTD.



ANALYSTS WANTED

There are more than 100 important projects at Bell Aircraft which have created new openings for analysts in a variety of capacities. These projects are in a dozen different scientific and technical fields and the assignments are of extremely challenging nature. Advanced projects are offering opportunities to qualified engineers for professional achievement with gratifying personal and financial rewards.

DYNAMICIST

— to supervise the work of engineers involved in dynamic problems relating to rocket engines, inertial guidance, servomechanisms for research aircraft and missiles. Problems range from design criteria to analysis and testing.

FLUTTER ANALYST

— to supervise the work of engineers responsible for flutter analysis and testing of research aircraft and missiles. Ability to determine effects of aerodynamics heating and servo systems on the flutter problems is necessary.

ENVIRONMENTAL SPECIALISTS

— to establish environmental, design and test criteria and test methods. Specialists in the field of vibration, shock, acoustics and temperature are required.

NUMERICAL ANALYSTS

— for IBM programming to prepare routines for basic mathematical problems which are combined to provide solutions to recurrent problems in aircraft engineering. Emphasis is placed on determination of methods and analysis of results.

RELIABILITY ENGINEERS

— to analyze and determine the basic cause of failures on servo, propulsion and electronic systems. Requires persons with diversified technical background, strong initiative, for considerable contact and discussion with Project Engineers.

OPERATIONS ANALYSIS

— Application of mathematical and physical concepts to weapons system evaluation studies and system analysis. Background in probability theory and statistical analysis desirable.

• For the career-minded engineer whose interests lie in these categories, contact...

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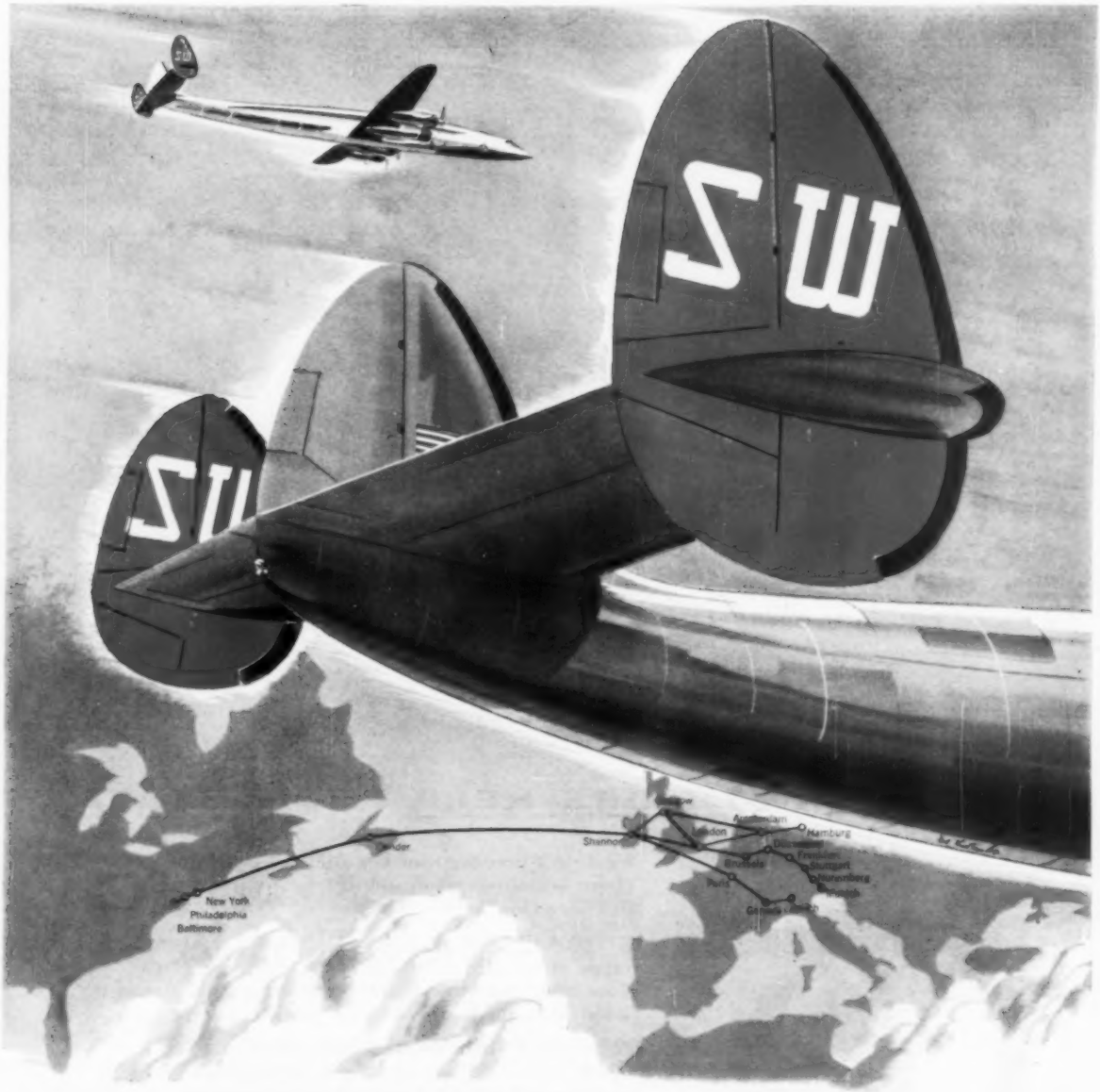

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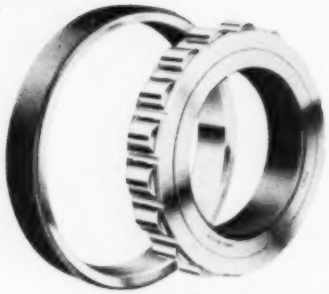

We didn't become number one just by chance. There are *three good, sound reasons* why—and here they are:

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2. HYATT HAS MORE EXPERIENCE AND EQUIPMENT. We have all the skills amassed in building far more jet engine roller bearings than any other supplier—*plus* the facilities to produce precision bearings which are successfully operating at speeds ranging up to 75,000 rpm.

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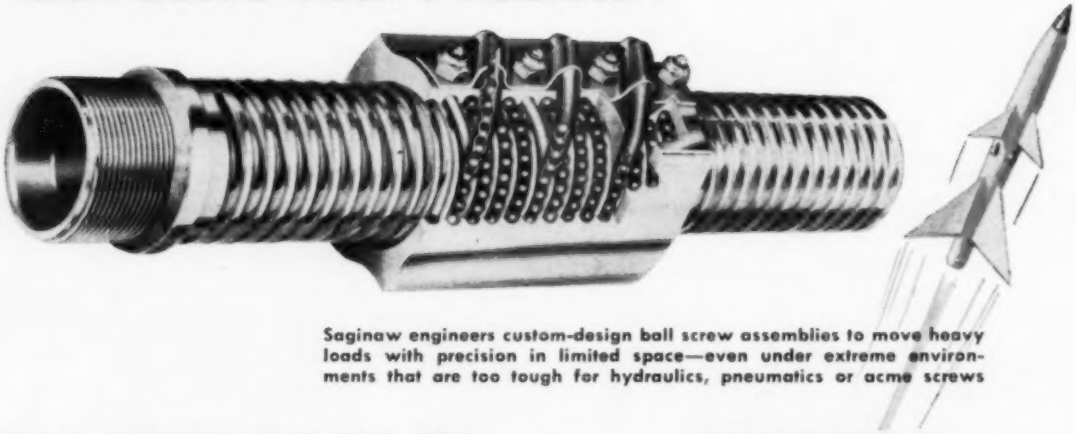


Saginaw engineers custom-design ball screw assemblies to move heavy loads with precision in limited space—even under extreme environments that are too tough for hydraulics, pneumatics or acme screws

ONLY SAGINAW HAS THE ENGINEERING ABILITIES, EXPERIENCE AND DESIGN FEATURES TO OVERCOME ALL THESE PROBLEMS:

LACK OF LUBRICATION

Even if lubrication fails or cannot originally be provided because of extreme temperatures or other problems, Saginaw b/b Screws will still operate with remarkable efficiency. Saginaw units have been designed, built and qualified for operation without any lubrication.

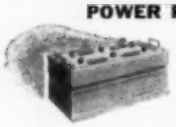
EXTREME TEMPERATURES

Normal operating range is from −75° to +275° F., but assemblies have been designed in selected materials which function efficiently as high as +900° F. These units are practical where hydraulic fluids have long since lost efficiency or reached their flash point, and cannot be employed.

PRECISE POSITIONING

Machine-ground Saginaw b/b Screws offer a great advantage over hydraulics or pneumatics because a component can be positioned at a predetermined point with hairbreadth precision. Tolerances on position are held within .0006"/ft. of travel.

POWER RESTRICTIONS

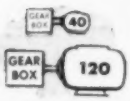


With guaranteed efficiency of 90%, Saginaw b/b Screws are up to 5 times as efficient as acme screws, require only 1/5 as much torque. This permits much smaller motors with far less drain on the electrical system. Less heat is generated; and circuitry is greatly simplified.

FAIL-SAFE PERFORMANCE

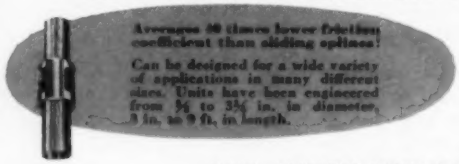
Far less vulnerable than hydraulics. In addition, Saginaw offers three significant advantages over other makes: (1) Gothic Arch grooves eliminate dirt sensitivity, increase ball life; (2) Yoke Deflectors and (3) Multiple Circuits provide added assurance against operating failure in critical applications.

SPACE/WEIGHT LIMITATIONS



Saginaw b/b Screws permit use of smaller motors and gear boxes; eliminate pumps, accumulators and piping required by hydraulics. In addition, Saginaw b/b Screws themselves are smaller and lighter. Units have been engineered from 1½ inches to 39½ feet in length.

REVOLUTIONARY BALL/BEARING SPLINE



Averages 80 times lower friction coefficient than sliding splines!

Can be designed for a wide variety of applications in many different sizes. Units have been engineered from ¾ to 3⅝ in. in diameter, 3 in. to 9 ft. in length.

Saginaw

ball bearing Screw

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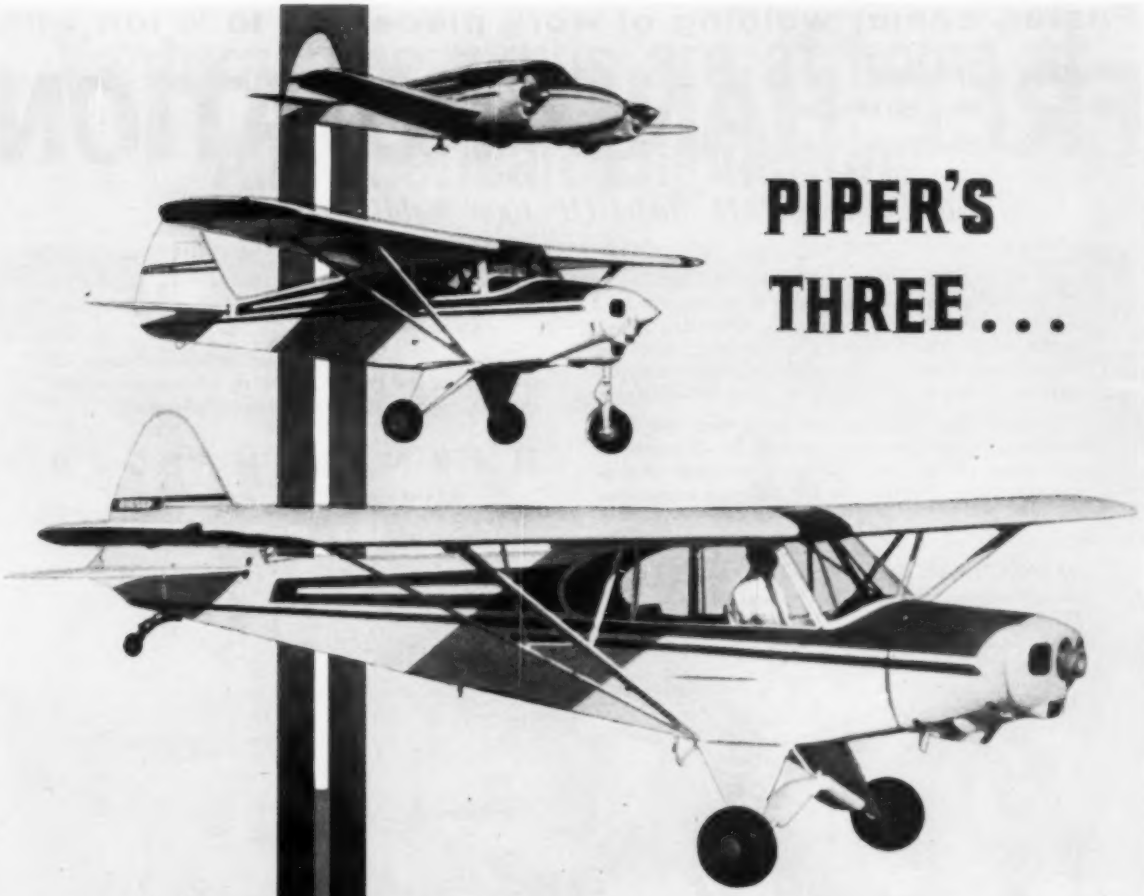

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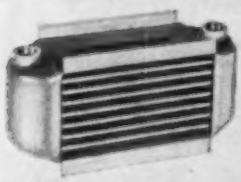

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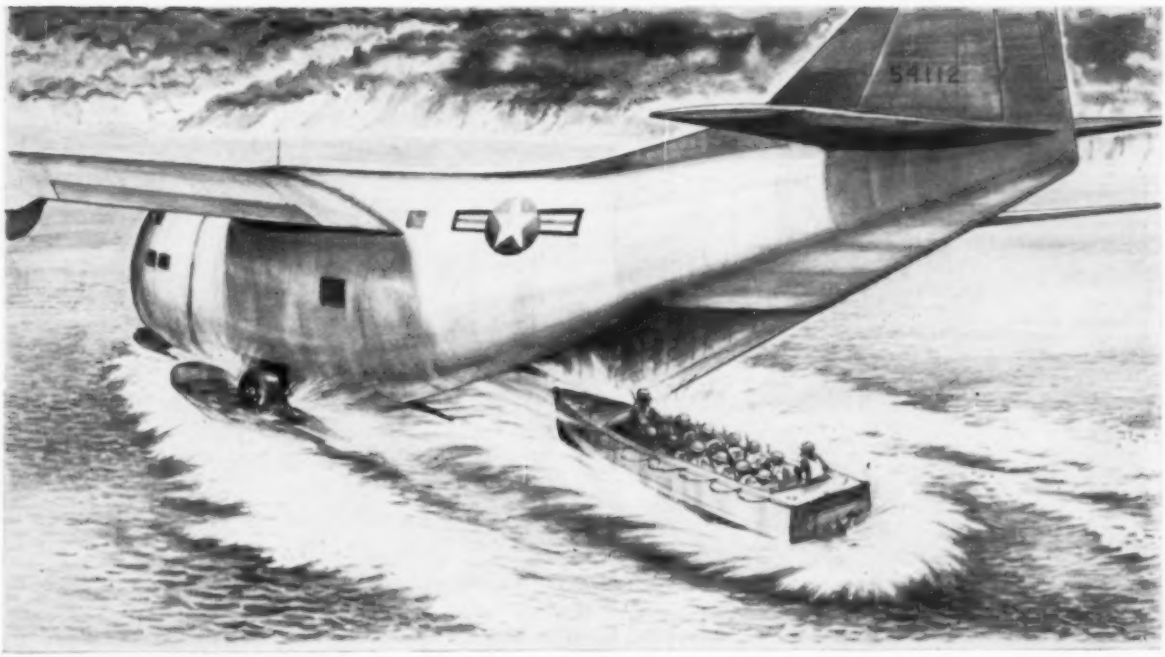


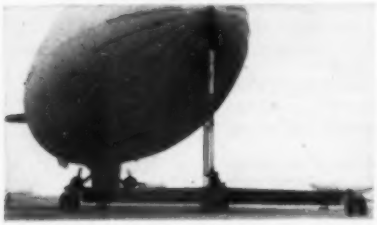
Many of tomorrow's realities in aviation are *today* on the drawing boards and in the test cells at All American Engineering.

Typical is the AAE design for airborne landing craft as envisioned here. In this design, the landing craft would be carried in a cargo plane equipped with hydro-lift landing gear and be disengaged into the water by the mother craft without loss of forward taxiing speed. Because it makes possible the landing of troops and cargo in shallow waters and inaccessible reef-surrounded areas, this is a design concept which promises important uses in air supply and troop mobility.

Like the recent headline-making AAE flying submarine, this advanced project comes naturally at All American. Here at this *proving ground for ideas*, the aviation industry and the military find a complete engineering and development service. Now in the project stage or actual production are various types of energy absorption devices, aircraft winches, universal landing gear, in-flight refueling and aerial tow gear, seat ejection trainers and air pick-up equipment.

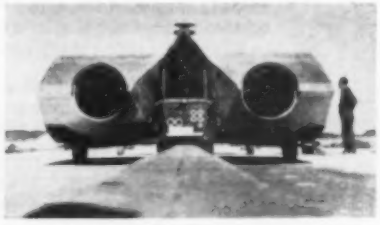
You will find at AAE ideal facilities, challenging assignments and rewarding experience. Investigate your career at All American.

A PROGRESS REPORT FROM ALL AMERICAN ENGINEERING



This advanced type portable mooring mast greatly extends the range and utility of the Navy's lighter-than-air submarine hunters.

Here is the All American Engineering test facility—one of the most complete—located at Sussex County Airport, Georgetown, Del.



This jet-propelled test car was designed by All American Engineering for the development of arresting gear and barriers.

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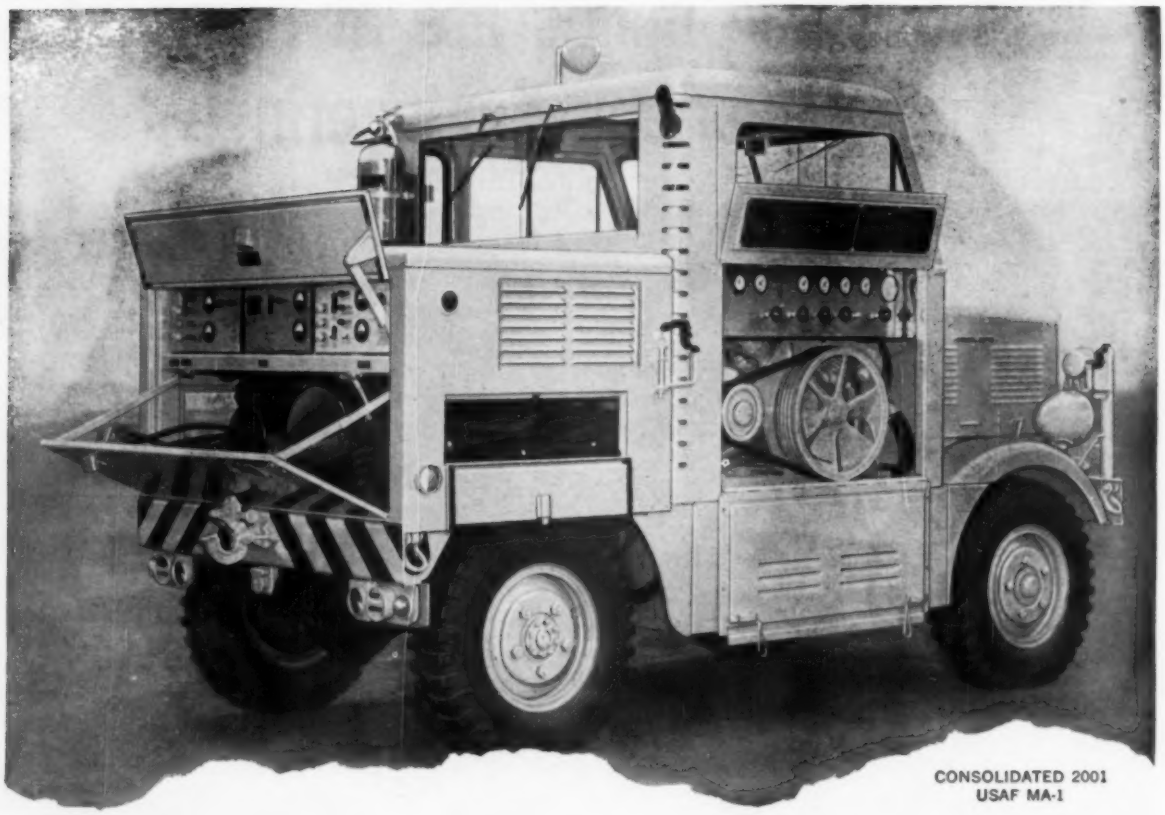

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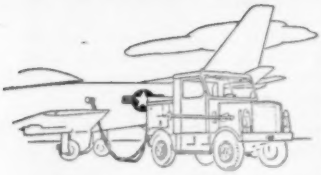
USAF MA-1

GROUND SUPPORT !



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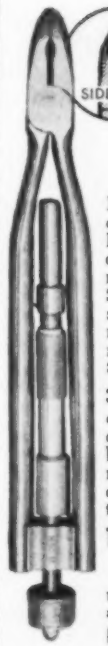

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LETTERS

On Synchrophasers

In the January second issue of AVIATION WEEK (page 26), an article appears on synchrophasing of propellers, giving erroneous credit for this development.

The history of the synchrophaser goes back to the early days of the war when Offner Electronics started development of an electronic control for jet engines as an independent project. Sufficiently promising results were obtained so that we proposed to Hamilton Standard an electronic propeller governor based on the same basic principles. Hamilton suggested that we attempt to include some means of synchrophasing. Starting with electro-mechanical methods, we eventually developed the all-electronic synchrophaser, which was successfully test flown as described in the article. Hamilton Standard cooperated closely with us in providing test facilities for the electronic synchronizer and governor and also by purchasing several test models which we had developed and constructed. However, all developmental work on the electronic synchronizer and governor was accomplished solely by Offner Electronics.

The synchrophaser, which we understand is presently being considered for the Super Constellation, is an outgrowth of this original development. Hamilton Standard having adapted the same basic scheme of synchrophasing to their existing Hydromechanical governors.

The original electronic jet control work was at the same time continued, with successful flight tests at Edwards AFB in 1948. Subsequently, we also started work with Hamilton Standard on this project, culminating in the electronic jet engine control used on the J57 Pratt and Whitney engine. Hamilton Standard built the hydraulic components for this unit, while Offner Electronics built the electronic portion.

At the present time, both electronic jet controls and synchrophasers are being built under our license, as we are not presently engaged in control manufacture, our facilities being devoted to our Dynograph direct-writing oscillographs—which incidentally are also an outgrowth of the jet control development.

F. F. OFFNER, President
Offner Electronics, Inc.
5320 North Kedzie Avenue
Chicago 25, Illinois

Worth of an Engineer

The article by Mr. Lefer on the shortage of engineers defined the problem rather well. The conditions discussed in his article have certainly been known to exist for a long time, but it is unfortunately true that the importance of having a sufficient number of engineers to man weapon-system design programs has been consistently ignored by the Department of Defense. To General Hershey, a graduate engineer is just another warm body worth exactly the same amount as his untrained brother in the equation that yields the true military effectiveness of the country.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

To date, no significant legal advantages have been taken of the Selective Service regulations. The number of trained engineers, contributing virtually nothing to the defense of their country, who are in the Army is appalling. There were close to 80 college-graduate electrical engineers in my company alone. These engineers, many of whom had several years of weapon-system experience, were performing duties that required a high-school education at most. With 80 engineers in one company alone, there must be thousands in the entire Army. Very few of these men are utilized in engineering capacities although each has the meaningless classification, "Scientific and Professional Personnel."

The most revealing aspect of the Defense Department's lack of concern about the engineering shortage is the fact that engineers being discharged are presently assigned to the Ready Reserve; and if they don't choose to become active reservists, they are put in the emergency replacement pool.

In the case of another Korean-type action, the many thousands of engineers separated under the present regulations would be among the first to be recalled.

Makes sense, doesn't it?

WILLIAM I. HARRIS
9116 West Swan Circle
Brentwood 17, Missouri

Right Peg, Wrong Slots

I am a graduate aeronautical engineer and received my commission in the USAF Reserve through the R.O.T.C. program. I have been on active duty for five months in the Air Defense Command.

I was called to active duty as an aircraft maintenance officer. Upon arriving at my initial base I was told that there was no immediate need for maintenance officers and that I would be utilized in Base Supply in an unauthorized position as an overage. I remained in Base Supply 45 days before being made an assistant to the organizational maintenance officer in the field maintenance flight. I served in this capacity for 90 days. At the present time I am serving as an adjutant. This position is also unauthorized and I am still on overage.

During this time I have explored all official channels and have talked to anyone who would listen concerning my reassignment to ARDC. I have also traveled to an ARDC Base to see if the need for my training did exist—it did.

After considering the above I can't help but think that someplace in the Air Force there does exist a slot I could fill which might offset a very humble part of our technical deficiency and at the same time give Uncle Sam more for his money.

NAME WITHHELD

TCA and No-Shows

I was very interested in your editorial in the April 2 number, "Tackle the No-Show Problem." I agree with you that the system of the European airlines is probably the most effective, but considering that in Europe a greater percentage of travel is terminal to terminal with less interchange between airlines, it is probably easier to administer; also here in the United States the more frequent use of air travel cards would pose quite an accounting problem.

Perhaps the U. S. carriers could adopt as an interim solution the system now in effect at Trans-Canada Airlines. TCA requires a passenger with a confirmed reservation to reconfirm his reservation twelve hours before departure time, and if he does not reconfirm, his reservation is automatically cancelled. As I travel frequently on TCA, I have found that I have more often been confirmed from waiting lists than has been the case on many of the U. S. airlines. I have also noticed that TCA flights very seldom have empty seats, which may indicate that their system of requiring reconfirmation may be a solution toward the no-show problem.

I find the suggestion by U. S. reservation offices to go out to the airport to try to get on as a stand-by irritating and impractical, considering the time and expense involved in most cities to go to the airport.

MICHAEL G. NEUBURGER
Manager, Export Division
Beech Aircraft Corp.
Wichita, Kans.

World Speed Record

Your editorial on the world speed record (AW March 26, p. 21) contains some pretty weak excuses.

If, as you say, your "new crop of 1,000 mph. U. S. fighters" are prevented, by security regulations, from showing their stuff, why should you try to minimize the accomplishments of another country's aircraft?

The only reason, if there is one, why the world speed record "rightfully belongs" in the U. S. is because you've probably held the various world records less than some other countries.

Surely, in these days of East-West tension, your efforts could be better expended by writing in big block letters that the West has the record, regardless of which of the free nations it may be.

G. R. WOOLL, Managing Director
Genaire Limited
Municipal Airport
St. Catharines, Ontario, Canada

(The world speed record rightfully belongs to any country that has an aircraft capable of flying faster than any other over the controlled conditions established by the Federation Aeronautique Internationale. It is a hollow victory for any country to hold the speed record in the face of other aircraft that can exceed its performance but are prevented from so doing by political interference.—Ed.)

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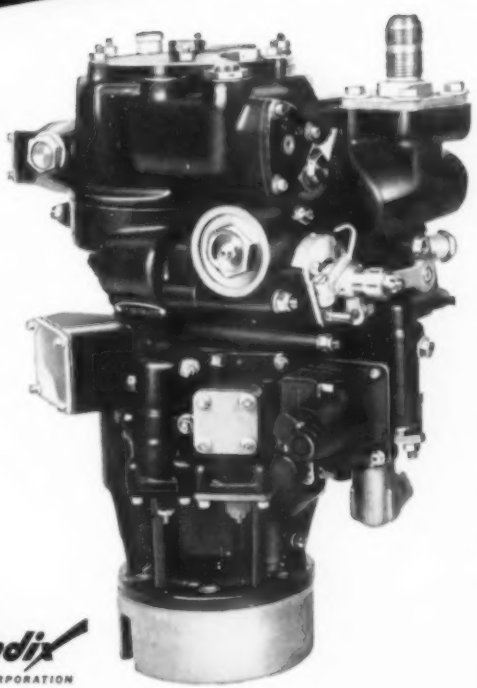

As early as 1945, Bendix brought out a jet engine control which automatically metered fuel during engine acceleration and deceleration so as to avoid over-temperature, compressor stall and "flame out". Since then, these features have become a "must" on all jet engine controls, allowing the pilot to slam the throttle wide open without danger of ruining the engine, or slam it shut without risk of "flame out".

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